INTERAVIA

REVIEW OF WORLD AVIATION

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Global Air Power

The USAF's Golden Anniversary

VOLUME XII 11 NOVEMBER 1957

Cobalt 60!

Behind a 36-inch-thick radiation-resistant window deep within the first laboratory of its kind in the industry, Goodyear scientists are unlocking a whole new field of rubber research—studying the radioactive efforts of powerful Cobalt 60!

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COBALT 60 is there as part of an extensive pioneering study which is destined to unlock the vast secrets in a whole new field of rubber research.

From it may come the first rubber which can resist atomic radiation, new tires for trucks and cars which can run cooler, radiation-cured rubber which will outperform any now known, as well as food pasteurized through radiation, new "synthetic rubbers," and a host of new products yet undiscovered.

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INTERAVIA

Review of World Aviation

Volume XII **No. 11** **November 1957**

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FRONT COVER: The United States' global air power (reproduction of a mural in the Pentagon).

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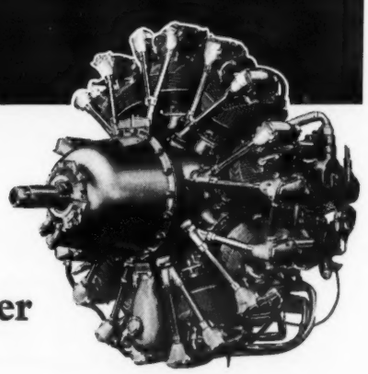

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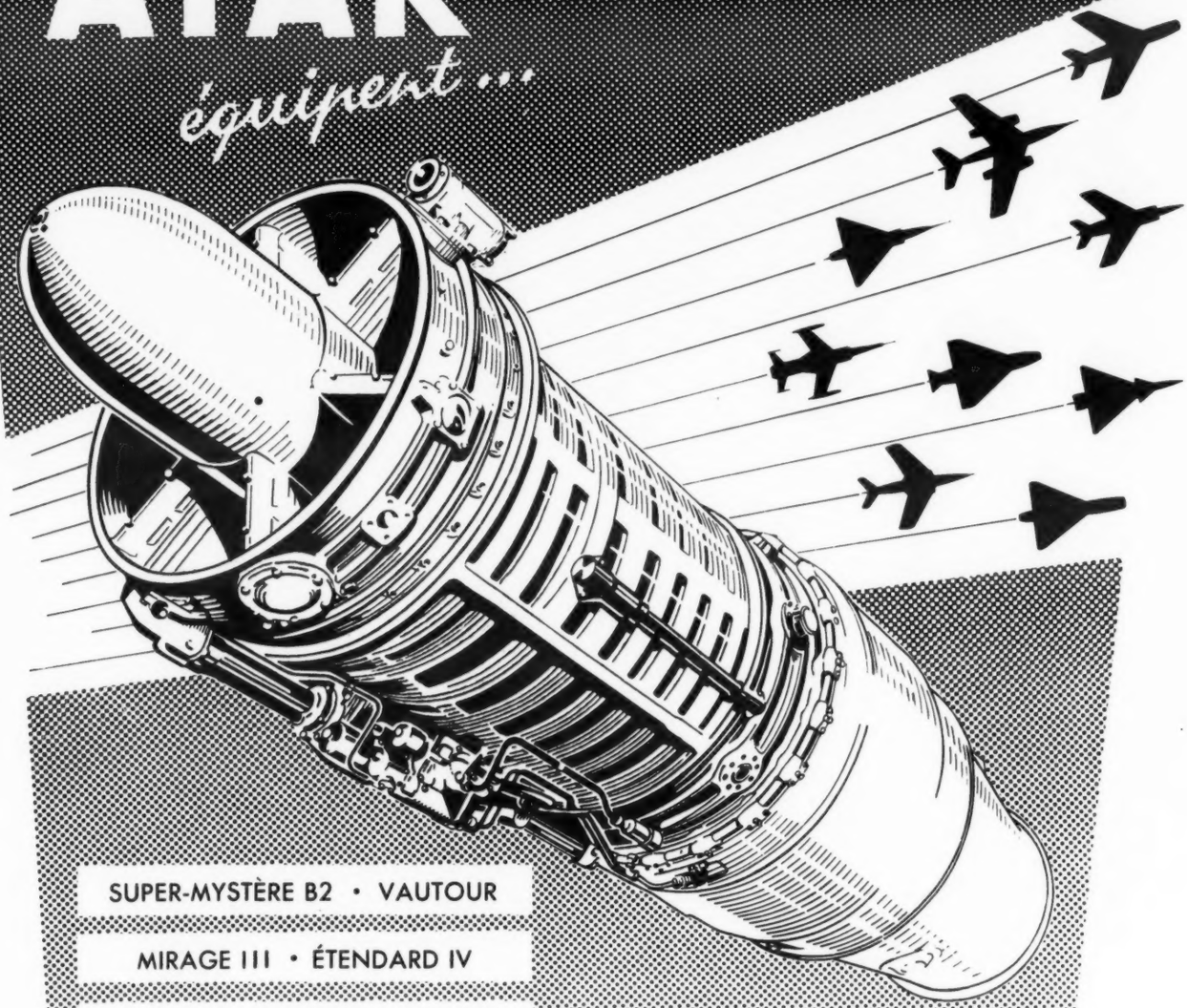

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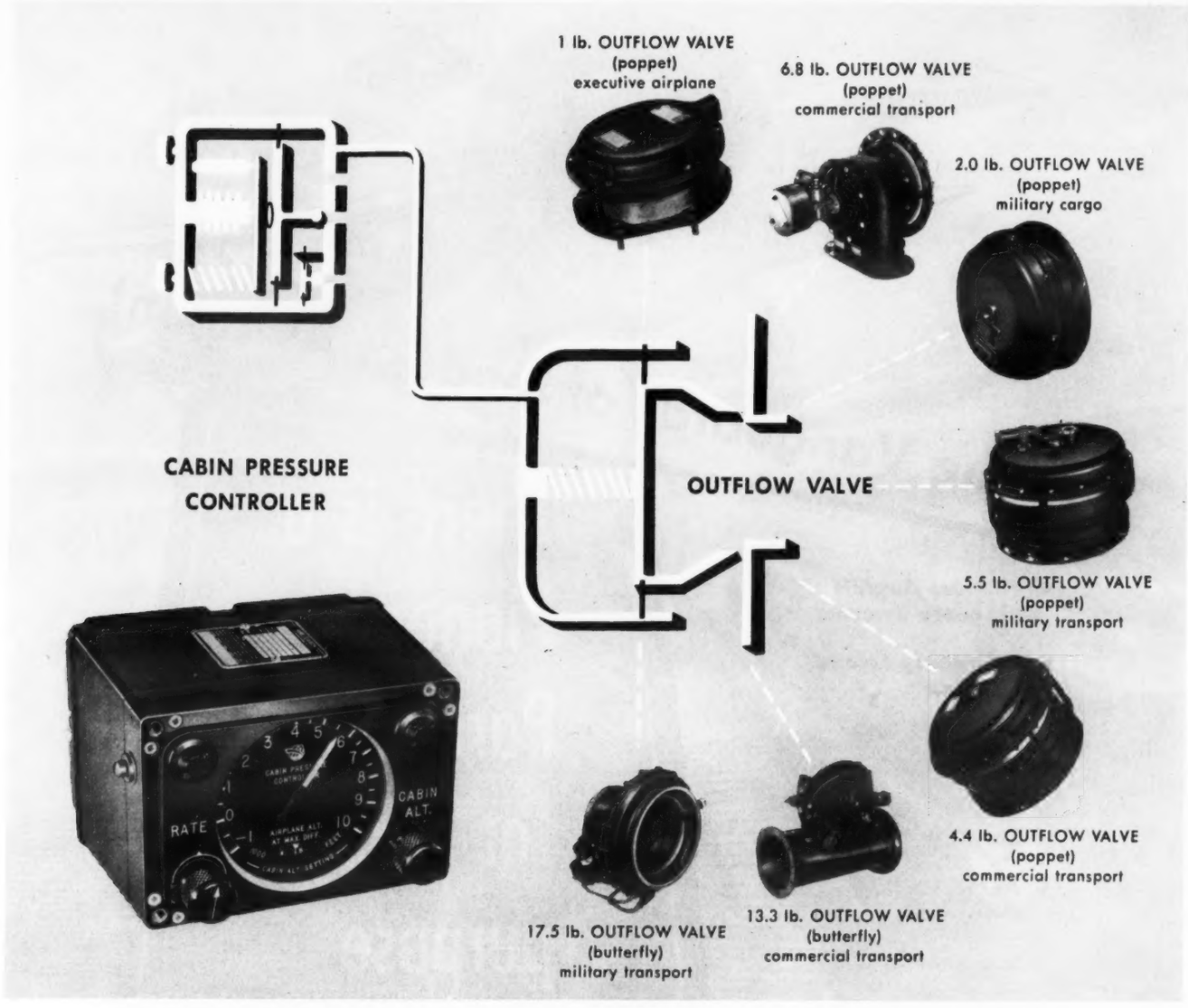

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5. Climb 1760 feet per minute, and attain service ceiling of 26,400 feet, at normal power.

6. Lift more than 44,000 pounds of cargo non-stop 1,750 miles with normal fuel reserve (or lift more than 32,000 pounds over 3,000 miles non-stop).

7. Cruise at 350 miles per hour.

8. Land fully loaded and stop within 3,050 feet.

Powered by four 4050 h.p. Allison (General Motors) 501-D22 engines, the mighty new 70-ton Hercules commercial cargo transport is America's first propjet aircraft designed to carry the goods of the world in the Jet Age—and generate extra profits for airline operators.

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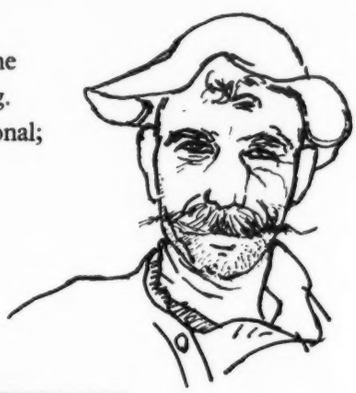

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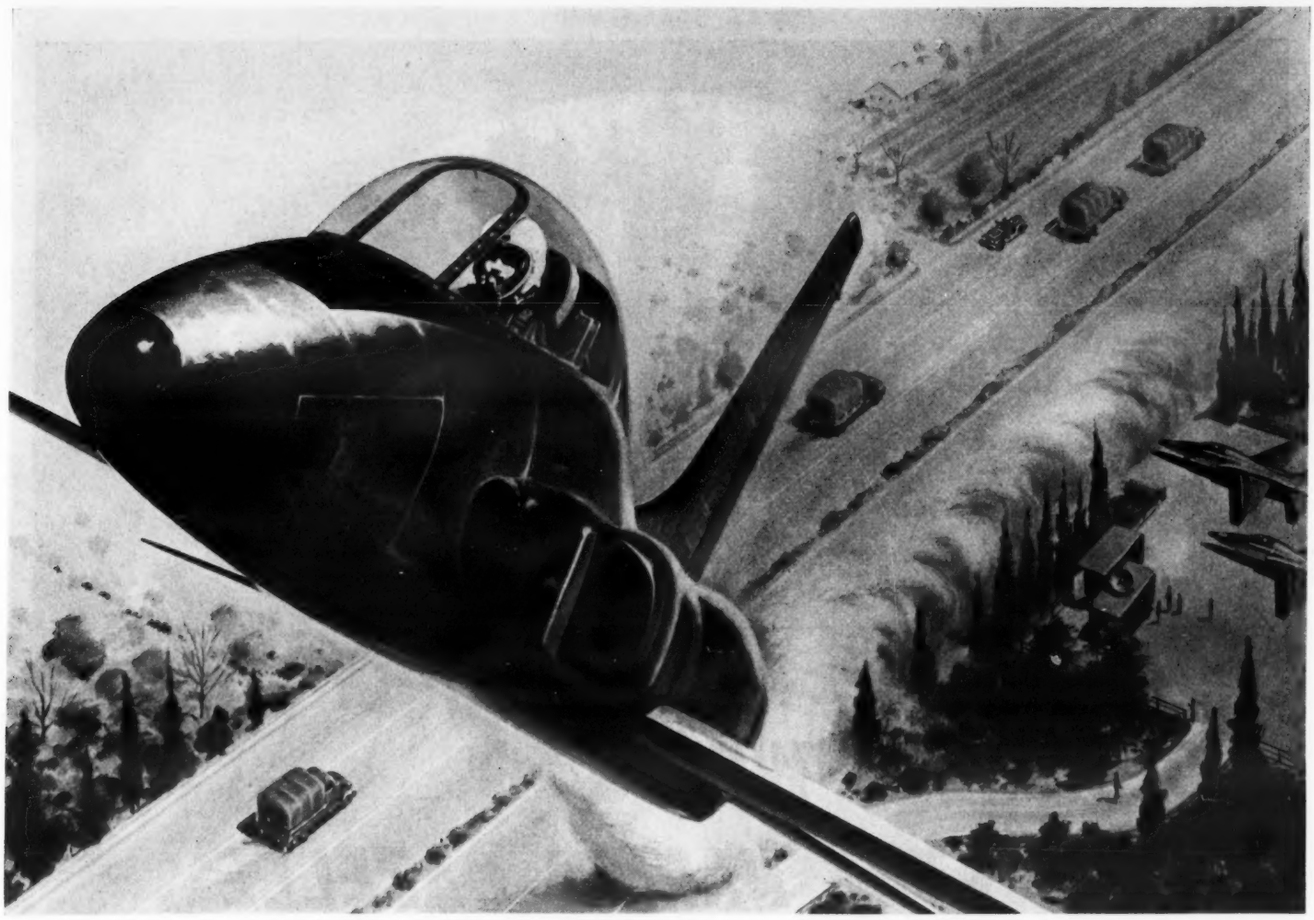

Northrop N-156F Takes Off from Highway

P-61 BLACK WIDOW

F-89 SCORPION

RP-70 DRONE

SM-62 SNARK

T-38 TRAINER

NEW counter air fighter for NATO

Designed specifically to meet the economic and military requirements of NATO countries, the Northrop N-156F is a *new* supersonic counter air fighter. Low in cost, light in weight, this twin-engine jet is not a re-work of an airplane built for another purpose, but was engineered from the beginning to fill aerial defense needs of NATO members.

The N-156F can operate from small or unimproved air fields or highways. It will consume much les fuel than heavy fighters... require fewer hours of pilot training. The simplified maintenance, using only a few basic tools and a minimum amount of ground support equipment, reduces the size and training time of ground crews. These important factors lower the cost of procuring and maintaining an efficient air force capable of performing the variety of missions required by modern military strategy.

The Northrop engineering and production team is responsible for such achievements as the P-61 Black Widow night fighters, F-89 Scorpion interceptors, Radioplane target aircraft, SM-62 Snark guided missiles, T-38 supersonic twin-jet trainers, and advanced missile systems. Now the N-156F joins the ranks of Northrop contributions for the defense of free world countries.

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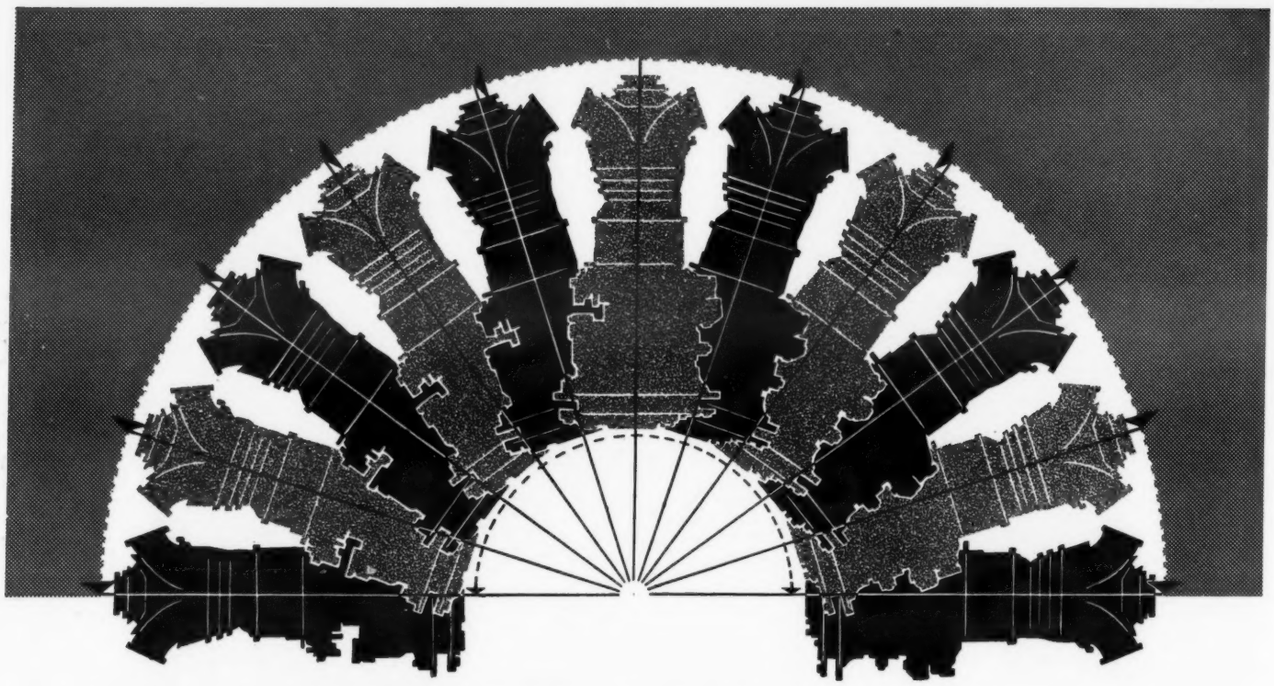
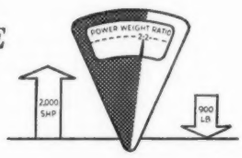


DESIGNERS WELCOME THE NAPIER GAZELLE

'Any angle' installation gives greater freedom

Napier's Gazelle offers a welcome break to 'tied' helicopter designers. This rugged free-turbine engine can be mounted on simple supports in the helicopter structure UPRIGHT, HORIZONTALLY, OR IN ANY POSITION IN BETWEEN.
This 'any angle' installation relieves the designer of many accepted limitations. It also gives him more opportunity to make proper use of fuselage space—valuable space which should, after all, be used for pay-load accommodation.

HIGH PERFORMANCE —LOW WEIGHT



The Gazelle has an impressive power/weight ratio. Originally designed for a power output of 1,260 s.h.p., it is now well on the way to developing 2,000 s.h.p. for a weight of 900 lbs.—a ratio of 0.45 lb./s.h.p. By removing the need for clutches, cooling fans, etc., the free turbine arrangement knocks pounds off the weight of the transmission mechanism.

30% RESERVE POWER

The design of the Gazelle provides a range of ideal helicopter powers. Among them are short-period emergency power outputs up to 30% above the normal maximum. Helicopters demand tough, reliable engines: the Gazelle is designed for strenuous duty and long service between overhauls. And when the time for overhaul comes, economical speedy maintenance is assured by the Gazelle's essential simplicity and the 'unit' principle on which it is built.

The Bristol 192—chosen by the British Royal Air Force —is powered by two Gazelles.

REPAIRS BY REPLACEMENT

This principle means that Gazelle components and assemblies are interchangeable—and easily accessible. Reduction gear, free turbine, compressor turbine and combustion system, compressor and accessories can all be replaced as self-contained, individually tested assemblies. The metering control unit can also be replaced as a rig-tested unit needing only minor adjustment.

The Gazelle is the most recent addition to the range of gas turbines made by D. Napier & Son Limited (London, W.3), who will be glad to supply further information.

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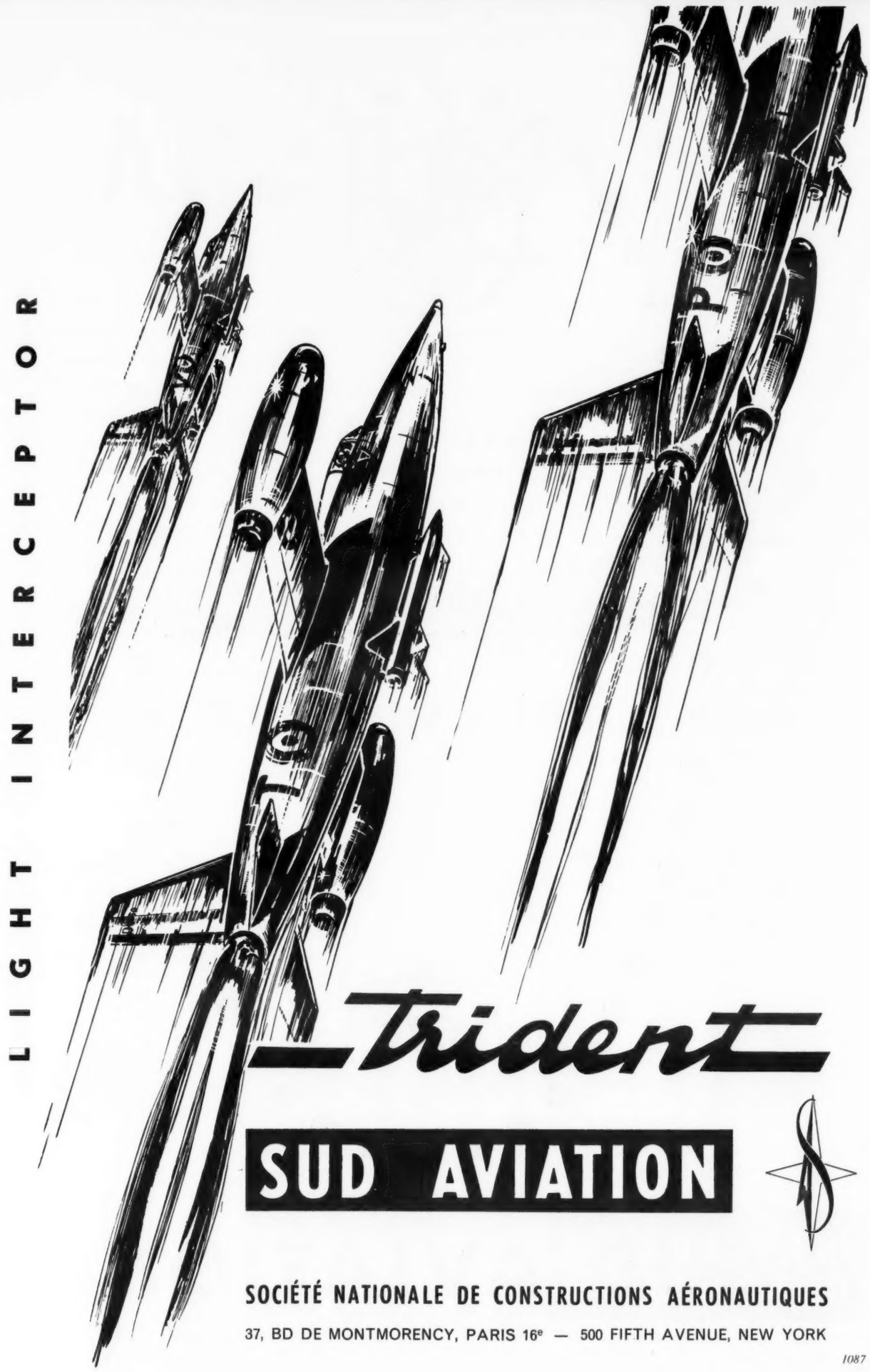

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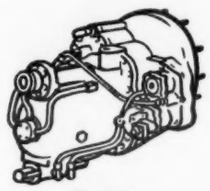
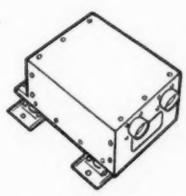
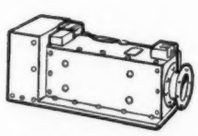


Constant Speed Drives

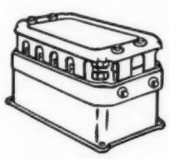
Alternators



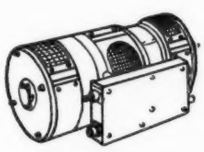
Alternator Control Panels



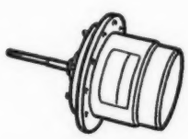
Transformer Rectifier Units



Circuit Breakers

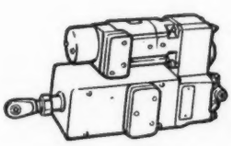


Invertors

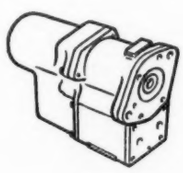


Pump Motors

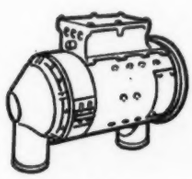
Generators



Linear Actuators



Rotary Actuators



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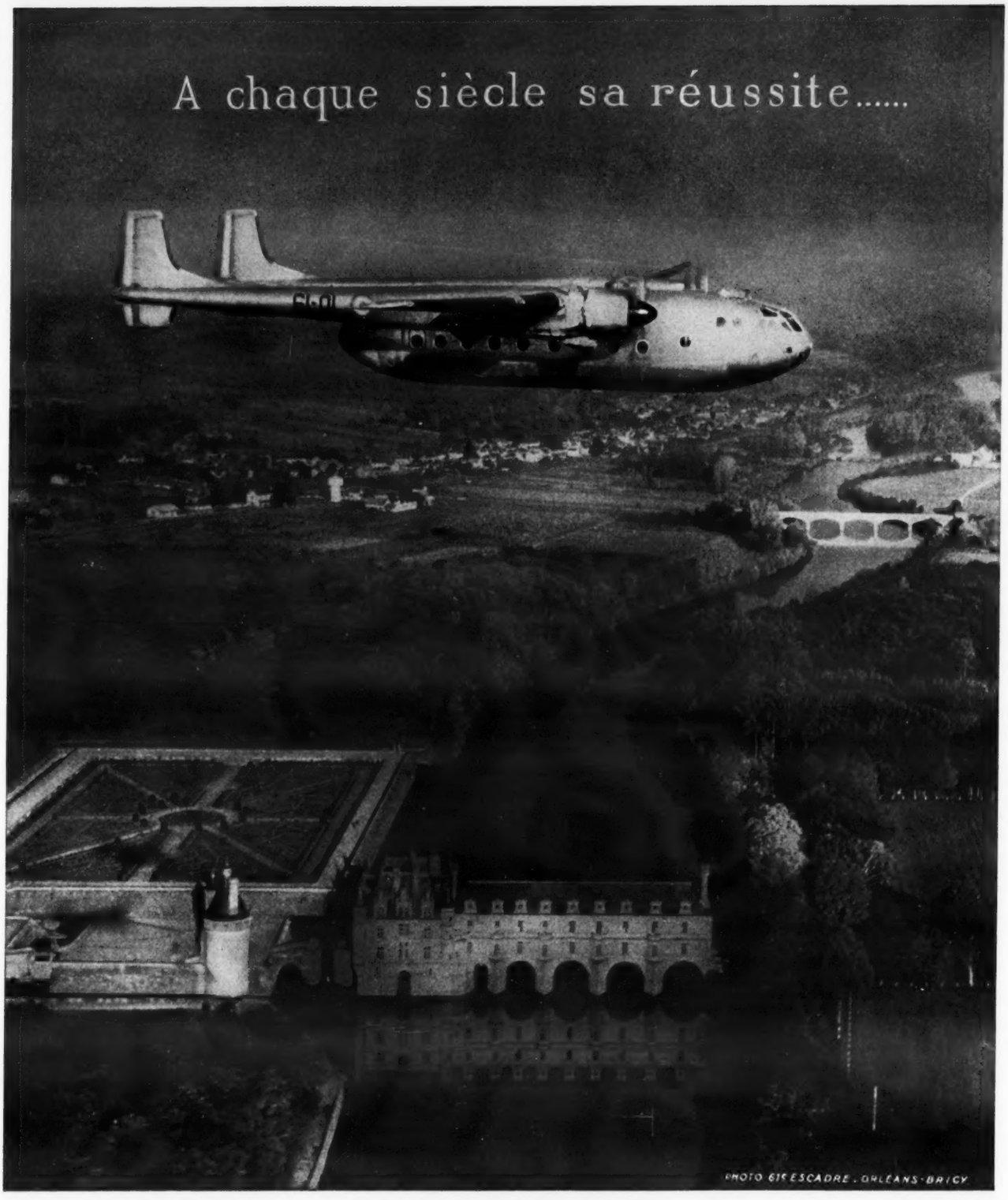

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CONTRAVES ITALIANA S. p. A. ROMA

CONTRAVES has been supplying gun directors for 11 years; they are used in 11 Countries both by Army and Navy.

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THE BAT, FIRE CONTROL SYSTEM FOR 40 mm. GUNS

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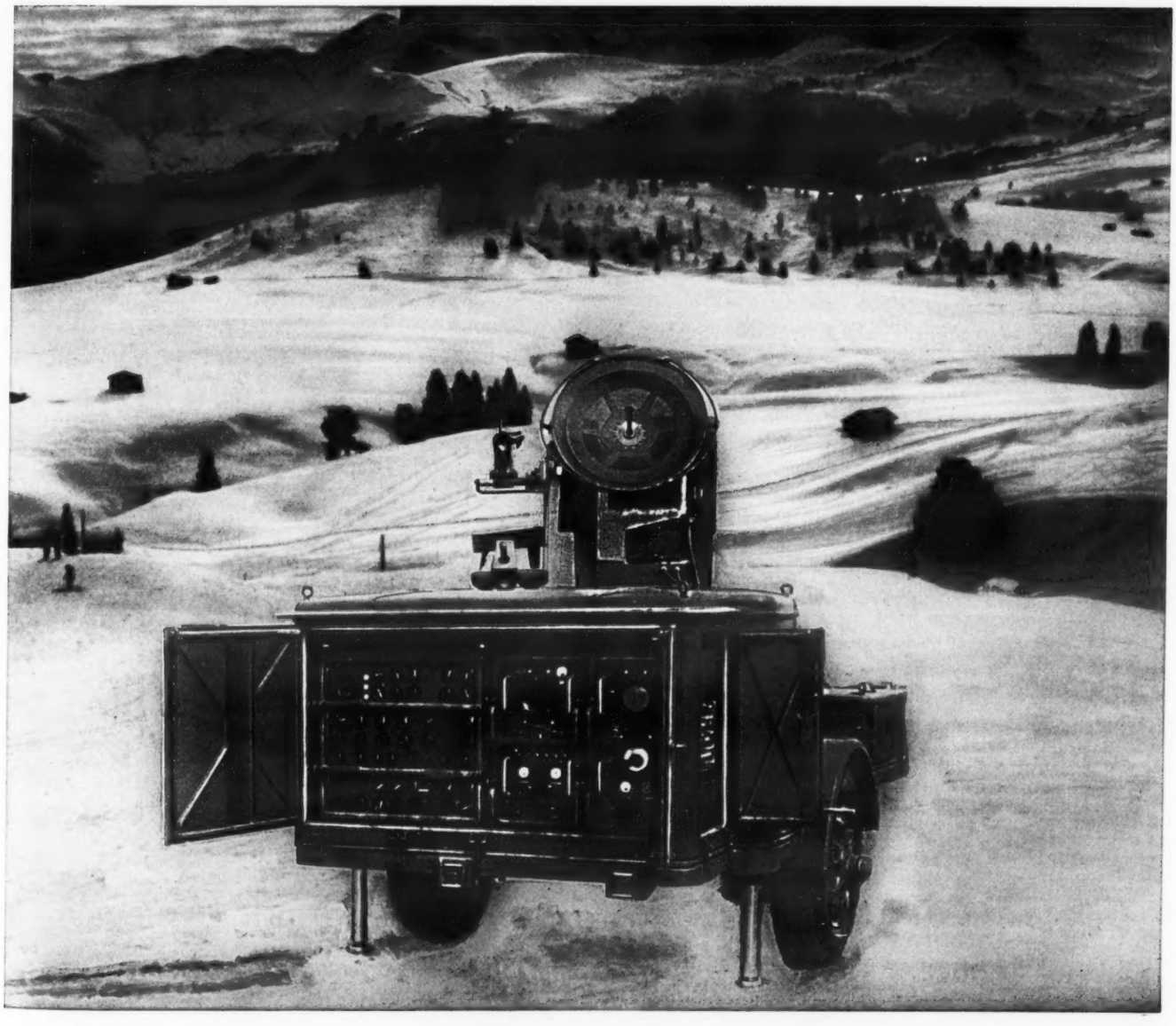

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The world of aviation relies upon Marconi's for radio and radar flying aids to match the range and performance of the most modern aircraft and to serve the traffic of the busiest modern airports. But more than that is expected of Marconi's. Working with Governments, Air Forces, Air Lines and Aircraft Constructors, Marconi's are devising electronic equipment which is helping to shape the future of aviation. A great tradition of pioneering and enterprise is being most capably upheld.

FOR LONG RANGE:
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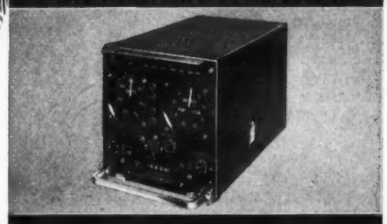
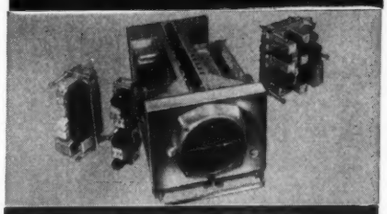
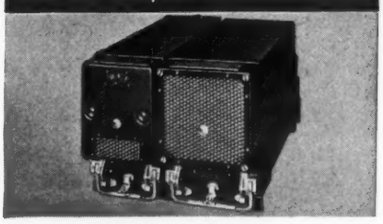


FOR MEDIUM RANGE: A.D.F



FOR SHORT RANGE:
VHF for VOR/ILS Communication



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INTERAVIA

Deadline Notes

No. 11, 1957

● **The appointment of Sir Matthew Slattery** as Chairman of Bristol Aircraft Ltd., and as a Director of the Bristol Aeroplane Company has been announced. Sir Matthew has gained a very high reputation in the aircraft industry after taking over Short Brothers & Harland and bringing it up to the position of an efficient profit-making concern. Sir Matthew joins Bristol at a time when big decisions are being made in the aircraft industry, and when new transport equipment is being planned by the airline corporations and the R.A.F. In the announcement of Sir Matthew's appointment there is a hint of closer integration between Short and Bristol, which may eventually lead to the fusion of the two companies, and possibly some contractual arrangement with a third company. Although Sir Matthew is Chairman and Managing Director of Short Brothers, reorganization to relieve him of some of his work has been achieved by the appointment of two deputy Managing Directors : R. E. Harvey, who has been General Manager since 1946, and H. G. Conway, who joined the company as Chief Engineer in 1954.

● **Rolls-Royce of Canada Ltd.** plans a 25 percent expansion of its Montreal plant facilities with the addition of some 27,000 sq. ft. of plant area at a cost of $1,000,000. The principal reasons for this expansion are the heavy demand for the Vickers *Viscount* powered by four Rolls-Royce *Dart* turboprop engines, and the increasing sales of the Fairchild F-27 airliner, powered by two *Dart* engines, and now being built in the United States. Additionally Grumman Engineering Corp. of Long Island has recently announced plans for equipping its twin turboprop *Gulfstream* executive aircraft with the more powerful *Dart 529* engines. Rolls-Royce consequently plans to set up a *Dart* overhaul line alongside the existing lines for the *Nene* jet engines, powering the R.C.A.F. T33 jet trainer, and the J34 line handling the powerplants for the Royal Canadian Navy carrier-based *Banshee* fighter. Storage capacity will be considerably increased in keeping with the company's 30-day delivery service policy. During the summer of 1957 the company's technical instruction school was also considerably increased to handle engineering personnel of the airlines using Rolls-Royce engines.

● **Latest CF-100 version dropped.** Production of the latest CF-100 interceptor, the Mark 6, has been stopped by decision of the Canadian Cabinet. An official announcement said that the decision resulted from a careful review of the defence programme made as a result of the need for economy, and in view of the rising costs of the defence programme generally ; the Government estimates a saving of $100,000,000 over the next three years by dropping the Mark 6. To avoid a big lay-off of the personnel at the Avro plant, production of the CF-100 Mark 5 will continue until the CF-105 *Arrow* series commences.

● **Boeing Airplane Company** has climbed back into the number one position in the Defense Department's lists of the one hundred companies receiving the biggest military procurement contracts from the armed services. The list covers orders placed in the 18-month period ended December 1956, during which time Boeing was awarded $ 1,900,000,000 in contracts, or 5.4 % of the total ; on the previous list Boeing took fifth place below North American Aviation Inc. at the head of the list. General Dynamics Corporation remains in number two position with $1,800,000,000 or 4.9 %. North American Aviation Inc. is now third on the list with $1,700,000,000 or 4.8 %. Fourth—United Aircraft 4.7 %, followed by : General Electric Co. 3.6 % ; Lockheed Aircraft Corp. 3.3 % ; American Telephone & Telegraph Co. 2.9 % ; Ford Motor Co. 2.4 % ; Douglas Aircraft Co. 2.4 % ; McDonnell Aircraft Corp. 1.9 % ; Hughes Aircraft Corp. 1.9 % ; Curtiss-Wright Corp. 1.8 % ; Martin Co. 1.8 % ; International Business Machines Corp. 1.2 % ; Chance Vought Aircraft Co. 1.2 % ; and General Motors Corp. 1.1 %.

● **Lockheed Aircraft Corp.** has received an order from the Royal Australian Air Force for twelve C-130 Hercules turboprop cargo-troop carriers at a cost of over $35,000,000. Included in the contract are spares, crew-training and support equipment. Delivery will be in 1958.

● **Supersonic Caravelle planned.** Sud-Aviation expects to develop a *Caravelle II*, and a *Caravelle III* as well as a supersonic *Super Caravelle*, according to statements made by Georges Héreil, President and Managing Director, to a group of visiting Scandinavian journalists. The Sud-Aviation executive disclosed that 272 French factories are participating in the Caravelle production programme, employing directly or indirectly some 12,000 people. As of May 1960 Sud-Aviation will be manufacturing four *Caravelles* a month and, if necessary, this figure can be stepped up to seven per month from June 1960. According to Héreil, production problems have already been overcome and all efforts are now being concentrated on sales promotion.

● **The flying qualities of the Fokker Friendship** on one engine in steep banks and during landing are shown in a new film by the Netherlands Film Company Profility. Shots were made with three cameras, one in the cockpit, one mounted on the portside fuselage near the tail, and the third on the ground.

● **Air Fouga** and Groupement Belge des Constructeurs de Matériel Aéronautique (Belgian Aircraft Manufacturers' Association) are discussing plans for the licence production of the French Fouga *Magister* jet trainer in Belgium, according to rumours circulating in Brussels.

● **Defense Secretary Neil H. McElroy** has now taken personal charge of the United States ballistic missile programme. The newly installed Defense Chief has said that continuing attention must be given to the removal or modification of any regulations which could conceivably impede progress, and has issued directives to the secretaries of the Army, Navy and Air Force to submit weekly progress reports both to his missile expert William M. Holaday, and to himself personally. In this connection it will be recalled that President Eisenhower recently stated to a news conference that the ICBM programme is now given priority. Less optimistic is the U.S.A.F.'s recent comment that the procurement of the *Atlas* ICBM has already been cut back three times during this year.

● **Britain to build more manned aircraft.** Despite the policy laid down in the Government's White Paper on Defence in April of this year, a change of plans and new data available indicate that more manned warplanes will be built in the United Kingdom. Completely new atomic age aircraft concepts are likely to fill the foreseeable gaps in offensive and defensive missiles. It is reported from London that one of these calls for a supersonic attack bomber, particularly for lower level bombing beneath radar cover. In the future, all military contracts are expected to involve a prime contractor and named associates. No contracts will be placed unless the recipient agrees from the outset to divide research, design and manufacture between at least two other firms. The system will ensure maximum manpower in individual jobs and will assist the industry in the present difficult period.

● **Proposed cut-backs in Canada's Defence Budget** for the current fiscal year are reported as being in the region of $200,000,000. The three services have been instructed to make

proposals for the reduction of current spending and it is assumed that the brunt of the economies will be borne by the armaments procurement programmes. Already changes in the structure of the Royal Canadian Air Force have been announced to come into effect in the near future : disbanding of all Auxiliary Air Force squadrons with the exception of flight safety and early warning units ; the end of the Government-sponsored University Reserve Officer Training Plan ; closure of a number of R.C.A.F. flying training schools ; disbandment of 14 Training Group Headquarters R.C.A.F. in Winnipeg ; transfer of Air Training Command headquarters from Trenton to Winnipeg ; and transfer of Air Transport Command headquarters and No. 426 Transport Squadron from Lachine, Quebec, to Trenton.

● **Japanese Air Force** expenditure in the 1958/59 fiscal year is envisaged at 36,000 million Yen, an increase of 10,500 million Yen over the current year. The total number of aircraft in service is to be raised to 991, including 397 jet fighters ; Air Force strength is to be brought up to 29,000 men, an increase of 8,900. It is expected that the United States will supply Japan with sixty F-86D all-weather fighters, and six C-46 transports, while eighty F-86Fs will be manufactured in Japan. In connection with the latter, the United States authorities have proposed to the Japanese Defence Agency Mission, which has been touring the United States, that the Grumman F11F-1 *Tiger* should be manufactured in Japan under licence. The complete Japanese military expenditure 1958/59 also includes a figure of 60,200 million Yen for the Army and 28,800 million Yen for the Navy. (100 Yen = US $0.28.)

● **Brigadier General Rodolfo Gentile,** Italian Air Force, has been appointed Deputy Director General of Civil Aviation and Air Transport at the Ministry of Defence (Air). The Director General of Civil Aviation is General Renato Abbriata.

● **The Tariff proposals** of the I.A.T.A. Traffic Conferences I, II and III held in Miami up to October 21st recommend the following fare adjustments, grouped by regions : *Western Hemisphere :* International fares within and between the Americas will be subject to some minor adjustments. New tourist and excursion fares will be introduced to develop new traffic, chief among them a special discount for groups of eight or more travelling together. *Mid-Atlantic :* Tourist class fares between Central America and Europe will remain unchanged. First class fares will go up $20. *South Atlantic :* First class and tourist fares between South America and Europe will be increased three percent. Emigrant fares from some European countries will be introduced. *Europe, Middle East and Africa :* Adjustments to individual fares resulting in some cases in increases of up to five percent. The present promotional excursion fare programme will be continued and some new items added. *Europe, India, Far East and Australia :* Little or no change in fares between Europe and India. Increases of four to five percent on tourist class and six to seven percent on first class services between Europe and the Far East and Australia ; but no increase on the Europe-Australia fare. *Asia, Australia and the Pacific :* Generally unchanged, with some increases, largely on first class services. *Trans-Pacific :* Fares over the North and mid-Pacific routes unchanged. On the South Pacific route, no change in tourist fares and a five percent increase on first class services. *Round the World and Polar Fares :* No change. A further Conference session at Paris on November 19th will deal with details of the new low-fare service on the North Atlantic and the related conditions and fare levels of the other classes of transport to be offered on the route.

● **Dollar loan for Air France :** Air France is to obtain a $78,500,000 loan from the Export-Import Bank in Washington to help finance an order for 17 Boeing 707 jet airliners at a total cost of $118,300,000, including the engines and spare parts. The loan, guaranteed by the French Government, is repayable within seven years after delivery of the aircraft (late 1959 or early 1960), and the interest rate is five percent. Taking part in the negotiations which preceded the signing of the loan agreement were Lazard Frères, the First National City Bank, Chase Manhattan Bank, Guarantee Trust Co. as well as Boeing Airplane Co. and United Aircraft Corp. According to informed circles, this is the highest loan ever granted by American banks to a foreign airline—a tribute to Air France's reputation in the international finance world.

Workshop Briefs

● Static and dynamic stress tests have been started on the first prototype of the Aer-Macchi MB.326 jet trainer. A second prototytpe is in an advanced production stage and the first flight will probably be in November 1957. A third prototype will be completed shortly.

● The new all-metal four-seat Omareal W-141 with two 25 hp engines is undergoing tests in Brazil. Omareal (Oficina de Manutenção e Recuperação de Avioes Ltda.) is preparing the W-141 for production.

● Additional details have been given for the projected Fiat 7002 helicopter, to be powered by the Fiat 4700.000 turbo-compressor unit with 530 gas-hp take-off rating : rotor diameter 39' 4 1/2" ; rotor cord 1' 5" ; fuselage length 20' 1" ; overall height 9' 5 1/2" ; take-off weight 3,087 lbs ; maximum speed 92 knots ; service ceiling with maximum load 11,150 ft. ; range 160 + nautical miles.

● De Havilland is offering a new freighter version of the *Comet,* known as the " 4C " ; this type is externally similar to the Comet 4B, but has a reinforced floor for freighting. The R.A.F. is showing interest, particularly for the Woomera run.

● The Convair 340, powered by Napier NEl.6 *Elands,* is due to leave for North America in mid-November. Demonstrations will be given in Ottawa en route to the U.S.A.

● Vickers Armstrongs has been discussing with the American local service carriers a new type of Viscount 700 specifically adapted to meet their requirements. Designated *Viscount 790* and powered by the *Dart 506,* the new type would be aimed at 150-mile stage lengths with full 280 knots cruise at 10,000 ft., with seating for 53 oor 63 passengers. All-up weight 61,500 lbs, and maximum payload 11,750 lbs.

● The Lockheed F-104 *Starfighter* is undergoing an exhaustive series of tests in order to determine its suitability as a bomb carrier. Experts comment that, in spite of its extremely high speeds, the F-104 could carry externally mounted bombs without great loss of performance.

● The French Air Force has increased the operating life between overhauls of the Hispano Suiza *Nene* jet engine to 660 hours. The engines, more than 1,000 of which have been produced by Hispano Suiza under licence, are fitted in the *SE.Mistral* and the Dassault *Ouragan.*

● Firth-Vickers Stainless Steels Ltd., Sheffield, has announced details of its new F.V.520 weldable stainless steel of high tensile strength and relatively low thermal expansion, coupled with corrosion resistance equivalent to that of the 18/8 steels. F.V.520 is available in the form of bar, castings, forgings, sheet and strip. Typical composition is : 0.07%C ; 16%Cr ; 6%N ; 1.5%Cu ; 1.5%Mo ; 0.3%Ti.

● Interest is growing in official circles over the proposed freight/passenger turboprop transport designed by Short Bros. round the *Britannia* wing. The aircraft is a high-wing monoplane with four *Orion* turboprops and a capacity for 60,000 lbs. (27,220 kg) of freight or 192 passengers. It is designed to cruise at 400 m.p.h. (347 knots) over ranges up to a maximum of 5,500 miles (4,780 nautical miles). Estimated operating costs are remarkably low with 6d a ton-mile or 1d per passenger-mile on ranges from 700 to 1,750 miles (610-1,520 nautical miles). With later developments of the *Orion,* costs are expected to go down to the region of 5d per ton-mile.

For initial flight trials, the aircraft—as yet unnamed—could be fitted with the Proteus 755. A very big point in its favour, particularly from the Government finance point of view, is that more than half the jigs and fixtures for the *Britannia* could be used.

● The first HA-1110-Mil two-seat aircraft developed by Hispano Aviación is now carrying out its first flight tests fitted with a Rolls-Royce *Merlin* ; this aircraft type is normally fitted with a Hispano Suiza engine.

Boosted off the launcher by rockets, Bloodhound is within seconds seeking its target at well over 1,000 mph

BLOODHOUND ENTRUSTED WITH MAJOR ROLE IN BRITAIN'S AIR DEFENCE

Bristol/Ferranti Bloodhound complete surface-to-air missile system tested, proved and in full production.

The widespread redeployment of Britain's armed forces, away from manned and towards unmanned weapons, is reflected in Bristol's production lines. Production of the Bloodhound guided weapon system is—with the exception of the Britannia airliner—the largest single activity of the Bristol Group of Companies.

The Bloodhound will become the mainstay of the United Kingdom defence network as surface-to-air missiles progressively take over from the manned fighter. Bloodhounds and their Bristol Thor-type ramjet engines have reached an extremely high stage of development. The system has already proved its effectiveness and is in production for the Royal Air Force.

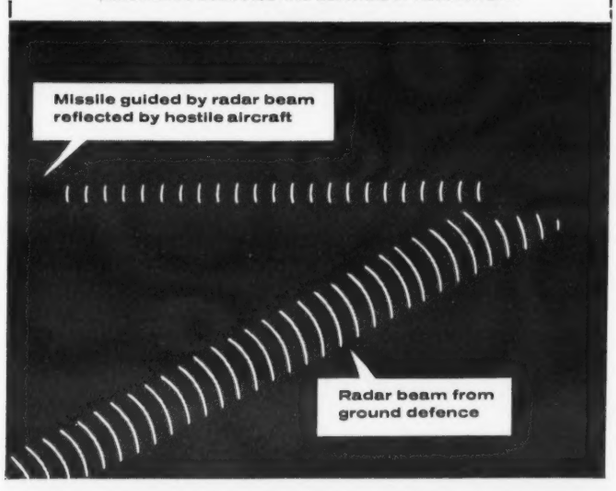
BRISTOL
Bloodhound

BRISTOL AIRCRAFT LIMITED

OPERATION : Bloodhound, with its Ferranti-designed guidance and control system, is a semi-active homing missile; this means that it is guided by a radar beam projected at the target and reflected back to receiving equipment in the missile itself.

As a hostile aircraft approaches, its position is plotted and followed by radars. Co-ordinates of this position are fed to the missile launchers which move automatically to bear on the target. As soon as the echo from the target indicates, by its strength, that the target is within range, a light flashes in front of the launch controller, who has only to press the firing button to send Bloodhound roaring into the sky.

ELECTRONIC GUIDANCE AND CONTROL BY FERRANTI LTD.



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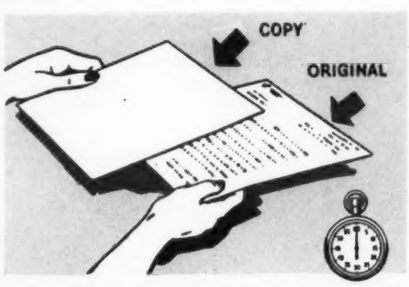

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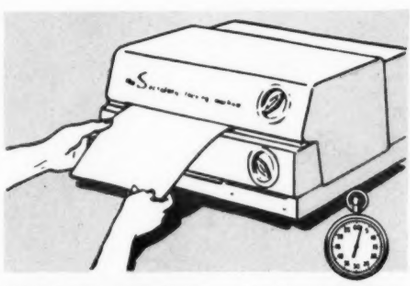

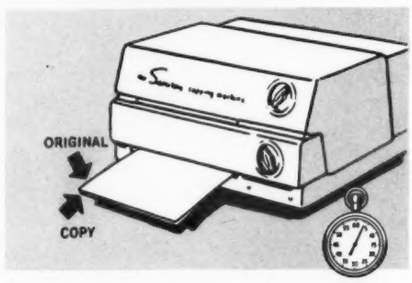

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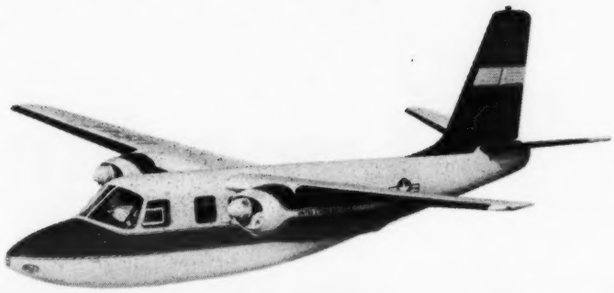
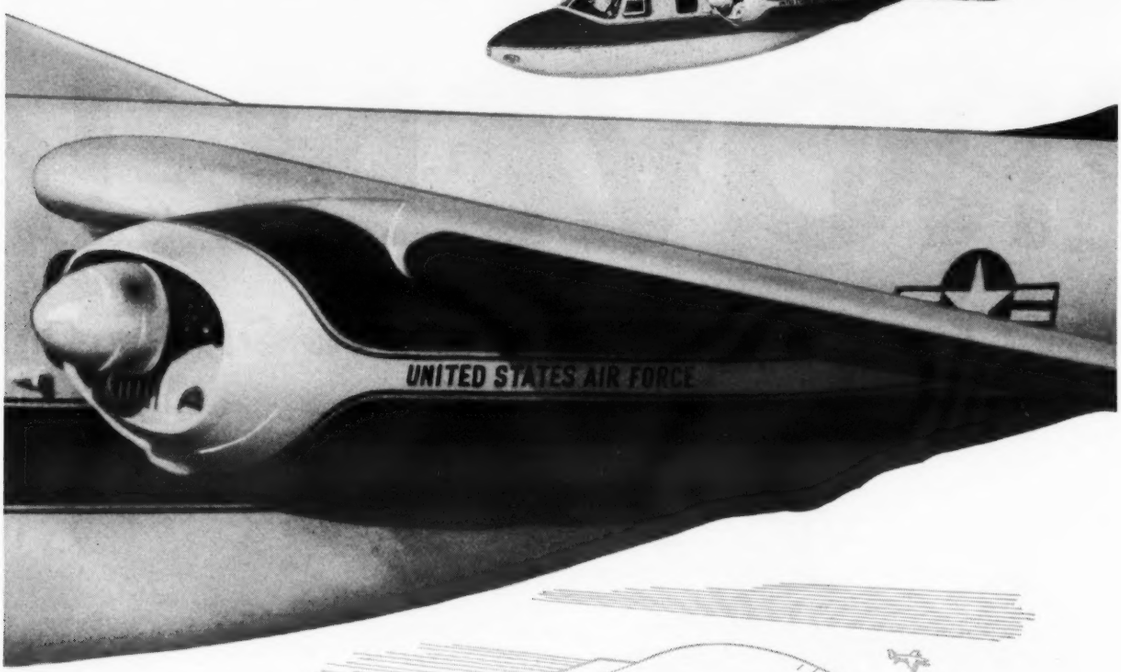
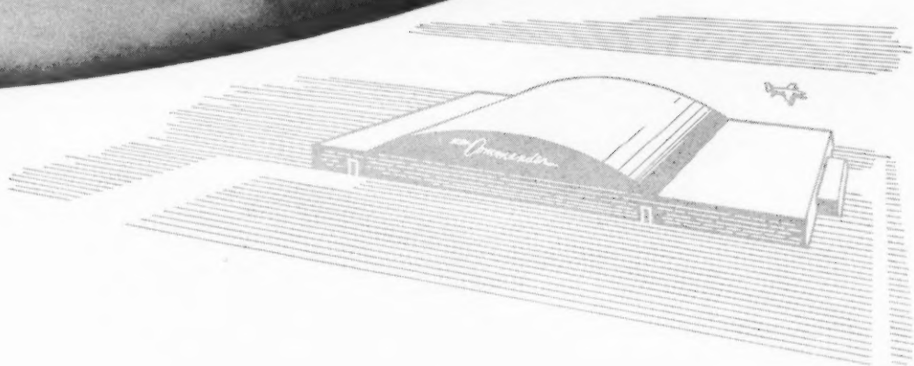
L-26B L-26C

TWO GREAT COMMANDERS

IN THE SERVICE OF THE U.S. AIR FORCE







EXPANDING

Aero Design & Engineering Co, manufacturer of the famous Aero Commanders for Military and Industry, is expanding to more than double present production facilities. The 1½-million-dollar expansion program will provide 46 acres for future growth. As in the past, all facilities will remain entirely Company-owned. The new Aero Commander factory at Tulakes Airport in Oklahoma City will be completed and in operation before the end of this year.

The choice of men at the top

AERO Commander

AERO DESIGN & ENGINEERING CO

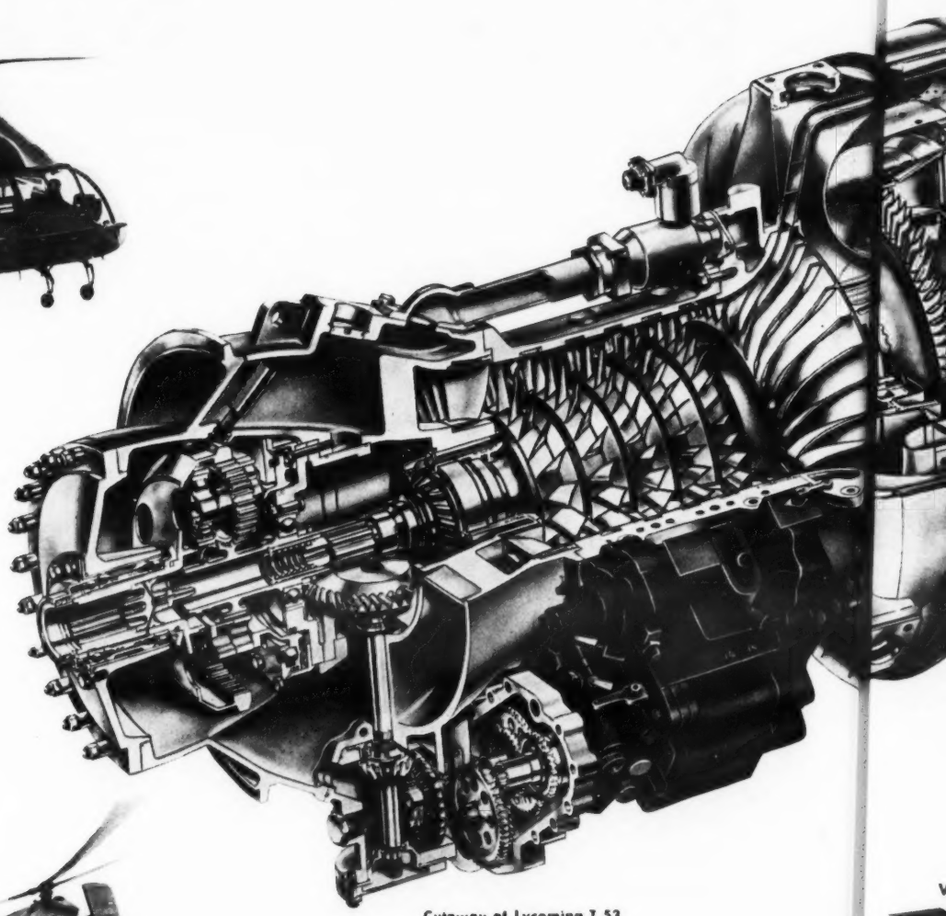
TULAKES AIRPORT • P. O. BOX 118 • BETHANY, OKLAHOMA

Lycoming's T53

PROVEN . . .

Low-cost T53 Registers More Hours Of Flight

Kaman H-43B



Cutaway of Lycoming T 53

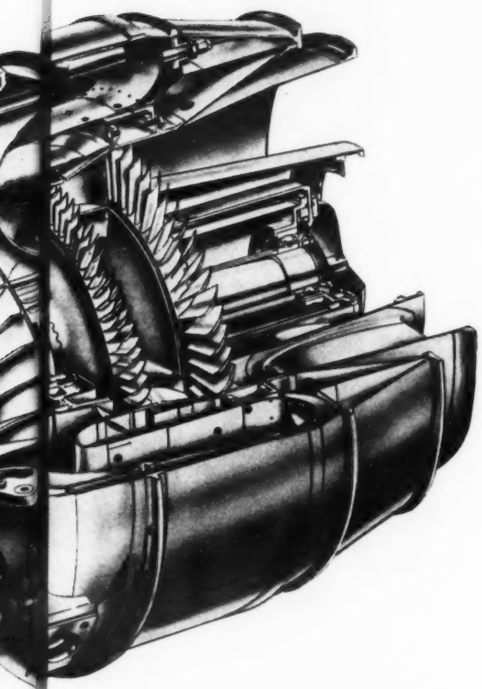
Vertol Model 105

Grumman Model AO-1

Bell H-40

IN FLIGHT

Time Than Any Other Comparable Turbine!



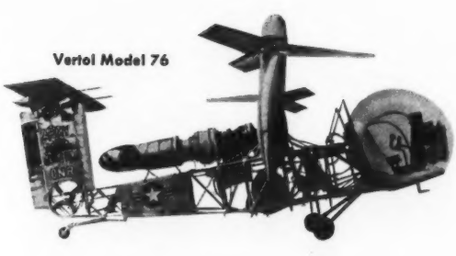
Its remarkably low production costs is but one reason why 6 major aircraft companies have selected the T53. Installed in the Bell H-40 and Kaman H-43B helicopters, the T53 has already earned a reputation as an engine "You can kick" and "Don't need to baby in flight". In addition, the T53 was chosen to power Grumman's new AO-1 High-Performance Observation Airplane as well as Vertol's Model 76 tilt-wing aircraft and Model 105 helicopter, a turbine-powered version of the H-21. The Ryan Model 92 and Doak Model 16 research aircraft—now being readied for flight—will also use the T53. In flying time experience, the T53 has recorded *more hours* than any other turbine engine in the same power class !

Built under the sponsorship of the U. S. Army and the U. S. Air Force, the low-cost T53 has also been installed in a power package for a high-speed U. S. Navy boat. Its easy adaptability to all sorts of applications has therefore been proven in practice.

Right now, the T53 helicopter version offers 825 s.h.p., but that rating will increase to over 1,000 s.h.p. in the foreseeable future. The current turbo-prop version delivers 1,005 e.s.h.p. from a compact 47.6″ length ×23″ diameter. The T53 operates on a number of fuels, including automotive and aviation gasolines and JP-4. Now nearing full production, Lycoming's T53 is designed especially for safety, durability, easy maintenance, as well as high power with low weight. Perhaps it can solve your future problems now !

Look to Lycoming

For further information, write to: Lycoming Division, Avco Manufacturing Corporation, 550 South Main Street, Stratford, Connecticut.

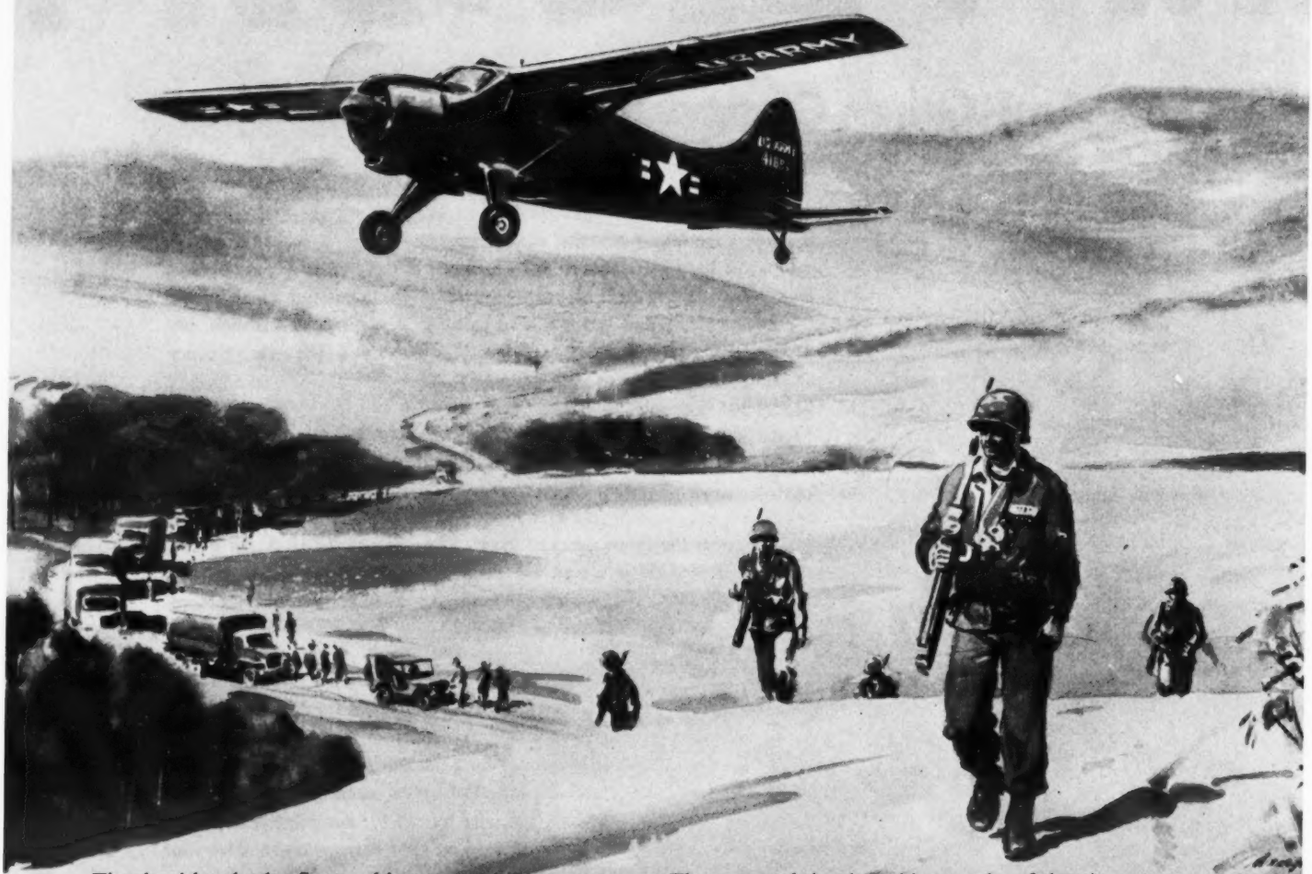


Vertol Model 76

Avco Lycoming

1,000 Beavers are in service

More than a thousand Beavers are now in service, their bases spread over the seven continents. They operate in every extreme of climate and in a wide diversity of civil and military roles.



Fitted with wheels, floats, skis, or amphibious gear, they operate from small airstrips, lakes or rivers. (The landplane take-off run is less than 600 feet.)

These rugged, hard-working trucks of the air can carry six passengers, or over half-a-ton of freight, for a distance of five hundred miles.

Designed and built by

THE DE HAVILLAND AIRCRAFT OF CANADA LIMITED

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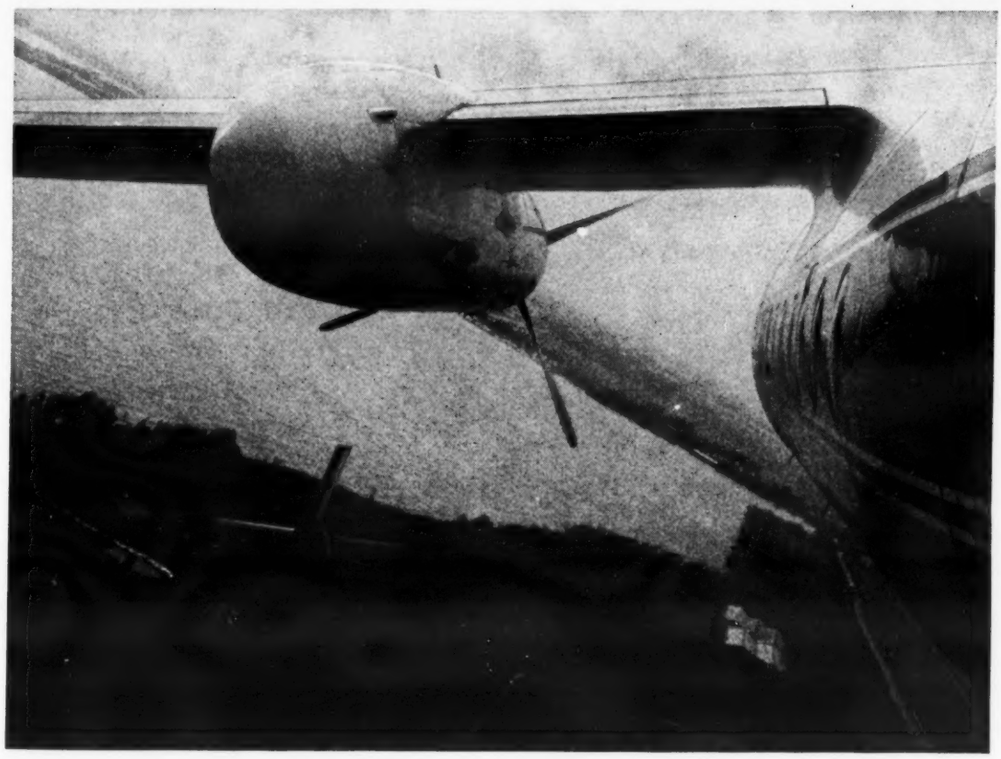

Friendship

An unusual shot taken with an outboard camera during a single-engine flight of the Fokker F. 27 Friendship

FRIENDSHIPS ON ORDER BY :
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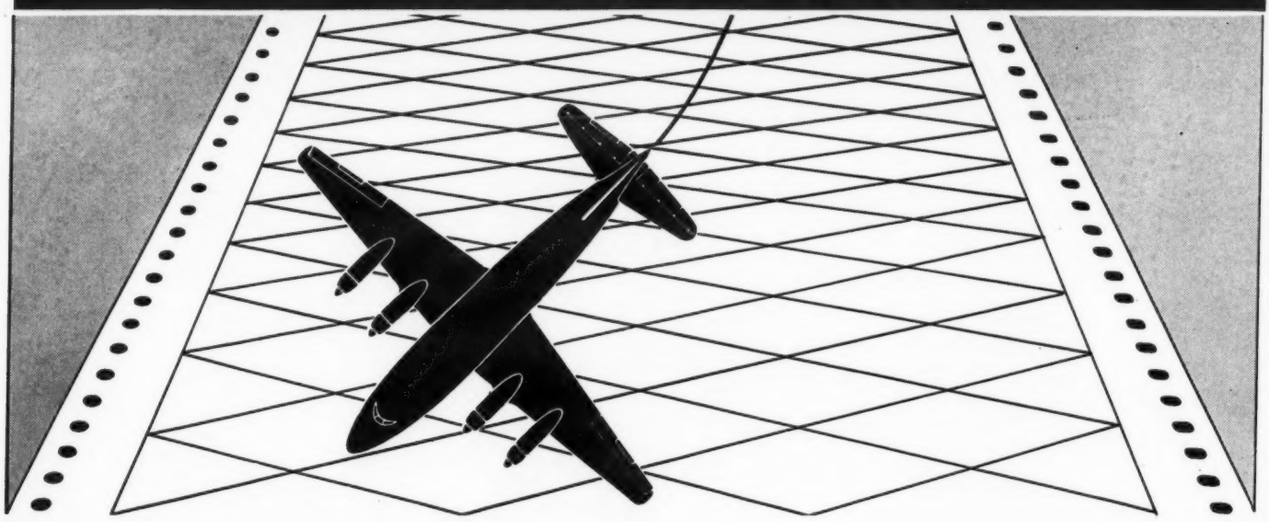
Fokker

Situation under control



The Decca System is fast becoming an integral part of the entire field of aviation. The Traffic Controller in particular has his task immeasurably lightened when Decca fitted aircraft fly on pre-determined tracks, and their pilots are able to follow instructions precisely. For the first time he can integrate aircraft of all types —fixed wing or rotary, turbo-prop or jet, into a single air traffic control plan. Decca fitted aircraft navigating accurately with reduced separation standards enable him to make the greatest use of the limited controlled air space. He can do so because Decca is the only system accurate enough to ensure that aircraft *can* fly on track, on schedule, at all altitudes, in all weathers, over every kind of terrain. Decca tracks and reporting points have been established in the London F.I.R. since July 1956, and are now being introduced at Frankfurt. Now that Dectra, the long range navaid for the North Atlantic, is on the air, the day when all the air routes of the world will be Decca flown comes nearer. Then indeed the situation will be under control.

THE DECCA NAVIGATOR

THE WORLD'S MOST ACCURATE NAVIGATION SYSTEM

THE DECCA NAVIGATOR COMPANY LIMITED LONDON

U.S. Aircraft Industry in Mid-October 1957

BY SCOTT HERSHEY, NEW YORK

The Defense Department's latest economy measure has stunned the aircraft industry and plunged it into financial gloom. This measure limits the amount of money the Air Force will pay monthly to producers of guided missiles and jet aircraft. Spokesmen of several major companies said they were "numbed... shaken... very much concerned" by the plan because they fear that limited payments will be smaller than those in the past on which manufacturers had depended greatly to finance their operations.

If that is so, the manufacturers will have to obtain more money; and if they cannot obtain the necessary funds they will have to reduce their total effort and cut down on their production of hardware.

At a final press conference, before his retirement, Secretary of Defense Wilson said the plan was adopted as a further measure in trying to keep military spending within the $38,000,000,000 annual limit imposed by the Administration to prevent a breakthrough in the national $275,000,000,000 debt ceiling. Defense spending in recent months has been running at a rate which would exceed $38,000,000,000.

Mr. Wilson said "we just don't want so many bills to come in and we want the aircraft manufacturers to cut down the expenses. They may have to reduce their buying of materials a little bit and run a little more economically, or they may have to lay off a few people".

One industry source said he gathered that Mr. Wilson just "doesn't know the full import of the limited monthly payment plant". The aircraft industry reflected gloom and pessimism, and spokesmen said that if the limited monthly payment plan is enforced to the letter it can pose grave financial difficulties to the manufacturers. They said it would be difficult to borrow money in the amounts which might be needed to finance their operations at the current level, and that banks and other lending agencies might be reluctant to make loans for fear of further cutbacks in the aircraft and guided missile programs.

It was noted that Mr. Wilson had said he did not believe an aircraft company would be able to carry as an allowable cost the interest on any loan which it effected. Asked if there was any way he could guarantee loans to an aircraft company "for emergency during this temporary period", Mr. Wilson replied that "they all have enough credit to handle this business. This isn't going to be so tough."

On this point he could get plenty of disagreement from the aircraft companies which already are slightly groggy from stretchout production programs for most of the newest supersonic fighter planes, and the cancellation of development work on some ballistic missiles and several assorted aircraft.

Mr. Wilson, on the other hand, said he hoped "no important change" in delivery schedules will result. The Air Force action calls on contractors to enforce strict economy measures, including financing of a higher percentage of work in progress, before seeking reductions in their present delivery schedules.

"While in some cases it may be necessary to adjust production schedules," Air Force Secretary Douglas said, "we would expect that full consideration would be given to a reduction of in-process inventories, overhead and the financing of a higher percentage of work in process for at least a limited period before any proposals are presented... for a reduction in present delivery schedules."

Mr. Wilson asserted that the other alternative to the ceiling plan would have been a direct cut in production, or flatly instructing plants with already reduced schedules to operate on a four-day week.

The impact of various aircraft stretchouts is expected to cut employment in the industry to about 800,000 by the end of the fiscal year from the 910,000 level before the big economy wave began rolling.

The latest economy measure on top of recent others will have an impact far beyond the aircraft producers themselves. Thousands of subcontractors and suppliers are involved and genuinely concerned and they, like the aircraft companies, are laying off men by the thousands over the country.

While the headlines are concerned with the aircraft industry, the effect of the economy measures is felt far down the line and involve the butcher, the baker and the candlestick maker in every community in which aircraft plants are located.

Typical of this situation is Long Island where Sperry, Republic, Grumman, Fairchild and a number of smaller subcontractors and suppliers have plants. Dr. William N. Leonard, Professor of Economics and director of the Bureau of Business and Community Research at Hofstra College, described the Long Island economy as facing its second period of shock and adjustments since World War II.

"The lay-offs in defense plants resulting from defense program cutbacks are beginning to hit the Island and they hurt," Dr. Leonard said.

Lay-offs in the hard-hit aircraft industry will continue and may have a severe effect on the economy of Long Island, he said, forecasting that many of those laid off will have to take lower-paying jobs in other industries. Dr. Leonard pointed out that two years ago, when there were many cutbacks in defense employment, the growth of shops and services plus the booming house-building industry created enough new jobs to carry the economy forward. But the building industry is faltering and further aircraft layoffs may not be offset by new jobs in other fields.

Lay-offs have hit 2,740 workers in Long Island's electronic and aircraft plants since the first of the year. Grumman recently released 500 workers and Republic said they would have to release an additional 1,000 employees cutting the firm's payroll to 14,500, about half of what it was at a recent peak. Liberty Aircraft, which receives 95 % of its work on subcontracts from Republic, will be forced to drop 100 workers out of a work force of 1,300. Defense lay-offs started in August when the Arma Division of the American Bosch Arma Corp., dropped 500 from its payroll. Following the later announcements by Republic and Liberty, the Reeves Instrument Corp. revealed that 100 of its 2,500 employees had been laid off because of "cutbacks and stretchouts".

The same story was being repeated in aircraft manufacturing centers throughout the country, especially in Southern California. However, in some other sections there are other facets of the economy to help cushion the lay-offs. The Long Island economy is built to a substantial degree on the aircraft industry, and while the effects down the line are not being immediately felt, the impact is bound to come as mortgages, instalment payments on washing machines, refrigerators and automobiles and bank notes become due and over-due.

Most aircraft industry spokesmen were reluctant to comment publicly on the situation and were agreed that it is too early to estimate the full impact of the economy drive, but privately they admittedly were in a quandary trying to cope with the limited monthly payment plan, coming as it did on top of cutbacks, stretchout and outright cancellations.

INTERNATIONAL MEETINGS AND CONFERENCES

Nov. 11th-13th : ATA - Air Traffic Conference Meeting, Miami.

Nov. 11th-19th : IRE - Institute of Radio Engineers - 3rd Instrumentation Conference and Exhibition, Atlanta, Georgia.

Nov. 12th-13th : 7th Vickers Aircraft Hydraulics Conference, Detroit, Michigan.

Nov. 13th-14th : IRE - Mid-America Electronics Convention, Kansas City.

Nov. 13th-15th : NATA - Annual Convention of the National Aviation Traders Association, Dallas, Texas.

Nov. 13th-20th : Technical Exhibition, Amsterdam.

Nov. 18th-26th : AGARD - 12th Session of the Combustion and Propulsion Panel, Washington.

Nov. 18th-29th : IATA - 10th Technical Conference, Miami.

Nov. 19th : IATA - Traffic Conference, Paris.

Nov. 19th-Dec. 16th : ICAO - 32nd Session of the ICAO Council, Montreal.

Nov. 21st-22nd : ADMA - 30th Meeting of the Aviation Distributors and Manufacturers Association, Detroit.

Nov. 22nd-Dec. 8th : 4th International Industry Fair, Bogota.

Nov. 23rd-25th : Transport Show, Toronto.

Nov. 25th : ATA - Board of Directors Meeting, Washington.

Nov. 25th-26th : AGARD - 7th General Assembly, Washington.

Nov. 26th : ATA - Annual Membership Meeting, Washington.

Nov. 26th-27th : AGARD - 11th Session of the Aeromedical Panel, Washington.

Nov. 28th : IATA - Technical Committee, Miami.

Nov. 30th-Jan. 29th : National Philippines Fair, Manila.

Dec. 1st-6th : ASME - Annual Meeting, New York.

Dec. 2nd-5th : ASME - Annual Meeting of the Aviation Division, New York.

Dec. 2nd-6th : ARS - 12th Annual Meeting of the American Rocket Society, New York.

Dec. 2nd-6th : International Automation Exhibition, New York.

Dec. 3rd-4th : AIA - Export Committee - Aircraft Industries Association, Palm Springs, California.

Dec. 4th-21st : OMM - 2nd Session of Regional Association III (South America), Caracas, Venezuela.

Dec. 7th-15th : 4th International Fair for broadcasting and radio equipment, Lioubliana.

Dec. 7th-Jan. 5th : International Industrial Exhibition, Santiago de Chile.

Dec. 8th-22nd : Thailand Industry Fair, Bangkok.

Dec. 9th-13th : IAE, ACM, AIEE - Eastern Joint Computer Conference and Exhibition, Washington.

Dec. 16th-18th : The Mission and Methods of the Airways Modernization Board. Air Traffic Control Symposium sponsored by the Franklin Institute, Philadelphia.

Dec. 17th : IAS - Wright Brothers Lecture.

Dec. 26th-31st : AAAS - Annual Meeting - American Association for the Advancement of Science, Indianapolis.

British Airline Fleet Programmes

by Interavia's *London Correspondent*

To be a success and provide an adequate return for the money invested in them, any future British transport aircraft will have to be built as part of a brand-new overall policy. For the first time since the war there are signs that the Government is beginning to grasp some of the rudimentary facts of life about building £1 million aeroplanes in a highly competitive world.

For the past two years Government airliner policy (or lack of it !) has been the subject of a great deal of criticism, and in most cases rightly so. The industry cannot be held completely blameless for some of the errors that have occurred, but unless a big project starts off with the right design backed with a sensible order book then it is doomed to run into trouble.

The recent *Britannia* snags, particularly with the *Proteus,* could have been avoided if the ordering had not been done in small packets and too late. B.O.A.C. ordered the *Britannia 100* in July, 1949, and the 312 in February, 1955. Transport Command orders for the type 253 were not placed until November, 1955. Thus B.O.A.C. has found itself in the unenviable position of acting as a proving ground for the *Britannia* for Transport Command, whereas if there had been clear-cut ordering from the outset the reverse would have been the case and the whole programme speeded up.

The days of ordering one or two prototypes of big aeroplanes and placing small orders with which to start production are gone for ever. The manufacturer must have a number of aircraft available for test simultaneously and they must have been built in production jigs so that there is no delay in getting on with deliveries. The United States adopted this practice years ago, but Vickers, with the *Vanguard,* are the first to do it in the United Kingdom.

The flight testing side has also always been a problem for transport aircraft in Britain and there is a tremendous need for some joint centre where military and civil transports can be put through their paces. In its report on the future of British air transport earlier this year, the Air League of the British Empire recommended the setting up of a Government-sponsored proving unit to do development flying of selected transport aircraft, and employing personnel seconded from the airlines, R.A.F. pilots and engineering staff, and manufacturers' representatives. The Government has had such an idea on its "pending" file for a long time, but they will have to implement it quickly if it is to be of any use for the next generation of aircraft.

The cross-roads in transport building have been reached because of the state of the industry following fighter and bomber cuts and the pressing need for a long-term re-equipment programme for R.A.F. Transport Command.

To maintain the new stockpiles at strategic points abroad, get the central reserve out quickly in an emergency, and keep up high speed communication between the U.K. and Woomera a sizeable number of aircraft will be needed. The swing to guided weapons will also call for specialized air freighting on a large scale.

Roughly the R.A.F. will need a high-speed pure jet transport, a long-range turboprop freighter, a medium-range general purpose turboprop transport and eventually, if the pace keeps up, a supersonic jet.

The high-speed jet (600 m.p.h.) category could well be filled by the long-range derivatives of the Vickers VC-10 which would greatly enhance the general prospects for that important aircraft. The long-range turboprop freighter will be a choice between a development of the *Britannia* or the Blackburn B. 107 evolved from the *Beverley.* Engines in both cases would be either Rolls-Royce *Tynes* or Bristol *Orions.*

To replace the *Valetta,* the A.W. 650 is so far the only contender and a military order would greatly enhance the chances of the type breaking into the civil market. The advantages of a joint military/civil development contract for a supersonic airliner are obvious, and they would give the long-suffering British taxpayer some promise of recouping some of the millions of pounds which would have to be laid down.

Some light in the present policy darkness will have to be forthcoming in the next few months or it will be too late.

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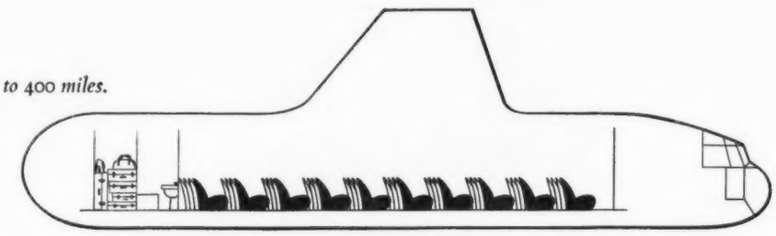
4 Roles for the Rotodyne

The Fairey Rotodyne will be the world's largest, most adaptable, and most economical helicopter. The arrangement within the Rotodyne's capacious fuselage can readily be adapted to suit local variations in traffic.

There are many territories, without established airports, where such extreme flexibility is of the utmost value. Furthermore, the Rotodyne is the first helicopter to offer operating economy directly comparable to that of fixed-wing aircraft over ranges up to 400 miles. It will cruise at 185 m.p.h.

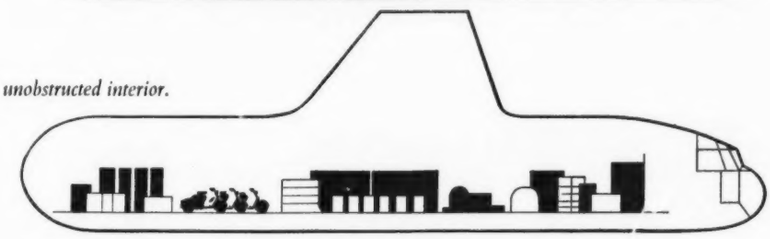
PASSENGERS (40)

Two-abreast seating for forty passengers over stages up to 400 miles.



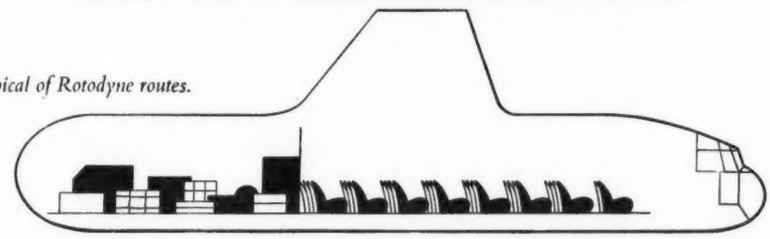
FREIGHT

Ten thousand pounds of freight are easily stowed in the unobstructed interior.



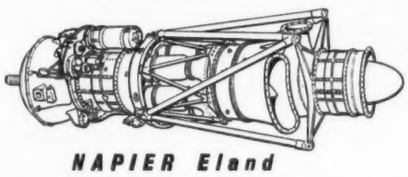
PASSENGER & FREIGHT

Mixed passenger-freight loads in any proportion are typical of Rotodyne routes.



VEHICLES

Large fuselage cross-section and clear floor offer ample capacity for vehicle ferry service.



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Two Napier Eland propeller turbines assure true twin-engine safety; they supply compressed air for the rotor tip drive, and a progressive changeover to full propeller thrust for maximum forward speed.

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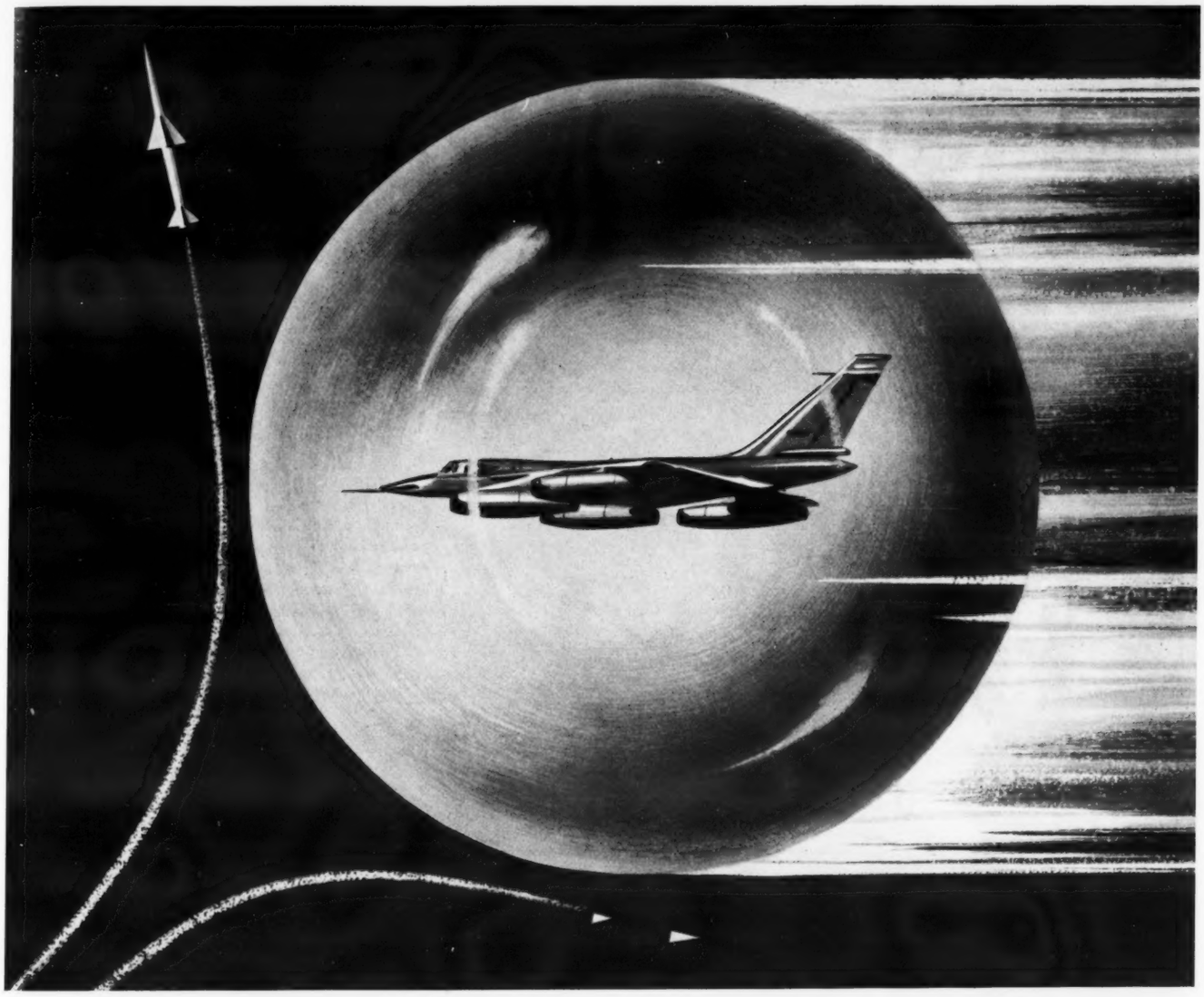

The Convair B-58 Hustler, first U. S. Air Force supersonic bomber, will be protected by Sylvania's electronic countermeasure equipment.

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Staffed with top-ranking scientists and engineers, backed by extensive research facilities and modern automated mass production capabilities—the Sylvania Electronic Systems Division is a major contributor to international defense plans. Intensive specialization in the Weapons System concept has resulted in utmost organizational efficiency, as well as the highest order of management competence.

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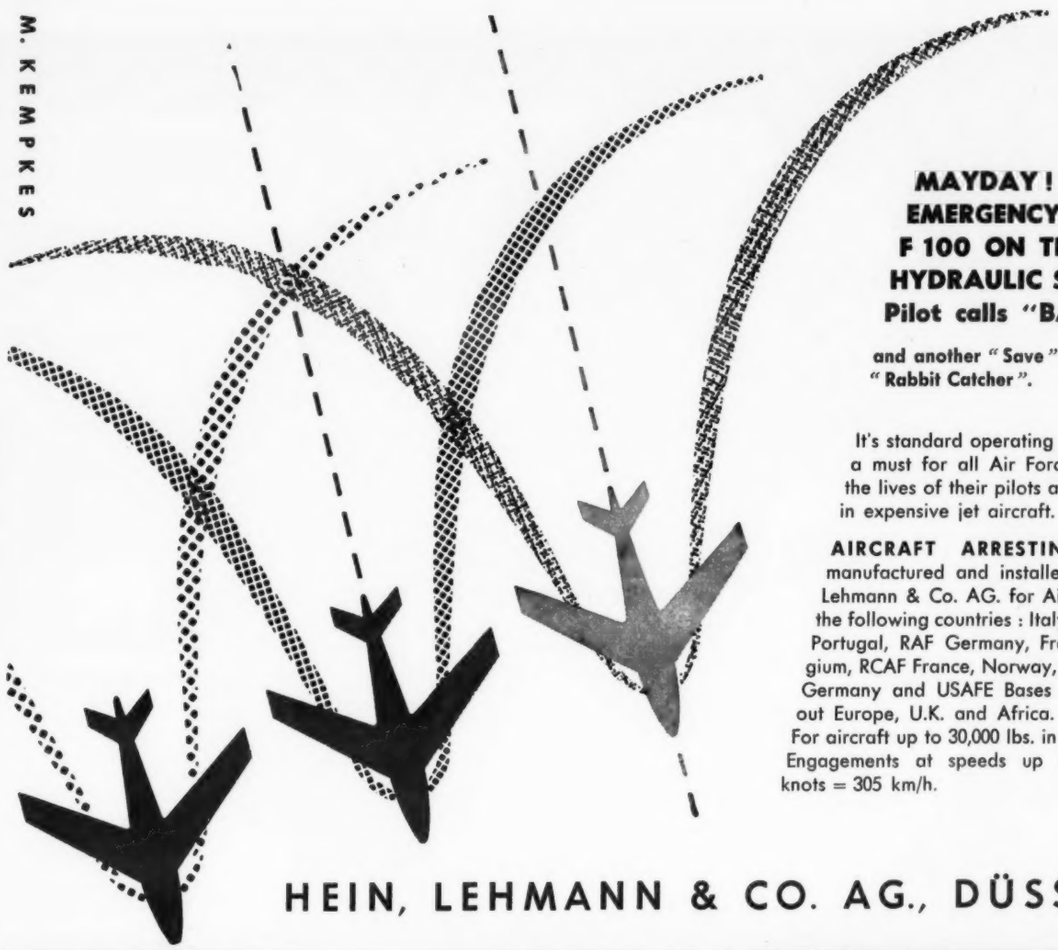

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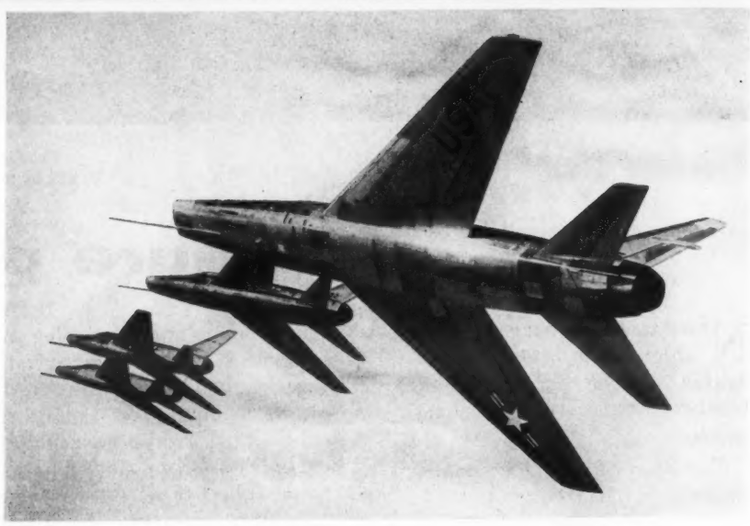
F-100 . . . wired for high temperature, supersonic flight, and Alaskan cold with Auto-Lite 350



North American's F-100 Super Sabre is designed to operate in extremes of cold, heat, and altitude. And that makes Auto-Lite 350 silicone-rubber-insulated wire about perfect for the job.
Flexible at —70° F., Auto-Lite 350 Wire also has high resistance to flame, abrasion, and to most aircraft hydraulic fluids, lubricants and fuels. In any installation where extreme temperature demands or chemicals are serious problems, consider Auto-Lite 350 Wire.
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ALLISON POWERS

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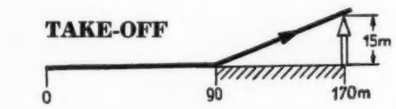
The prop-jet Hercules can take off with a 5,000-gallon tank truck — or 20 tons of combat cargo — and get to the scene of action close on the heels of the fastest jet bombers. Four Allison T56 Prop-Jet engines, driving Aeroproducts turbo-propellers, give it speeds of over 370 mph; range over 3,000 miles; and the ability to take off and land on hastily prepared air strips. The Lockheed C-130 is the backbone of the Tactical Air Command's combat support operations.

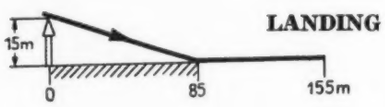
A commercial version of the Allison T56 will soon power America's first prop-jet airliner, the new Lockheed Electra. Allison engines are designed and built by America's pioneer producer of turbine aircraft engines.

ALLISON DIVISION OF GENERAL MOTORS - Indianapolis, Indiana

ALLISON Prop-jets and turbo-jets

GM GENERAL MOTORS





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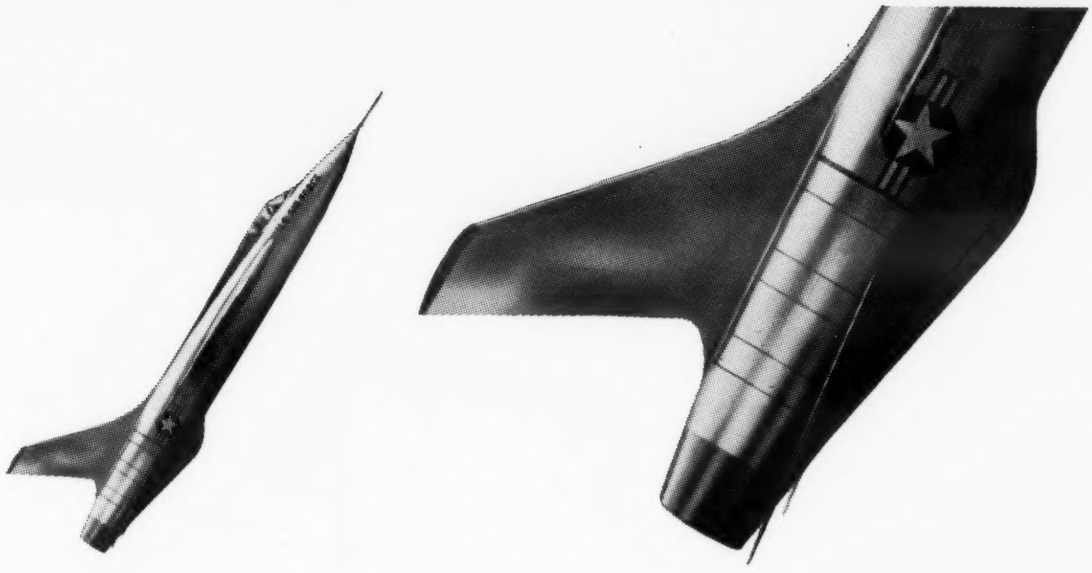

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THE F-105

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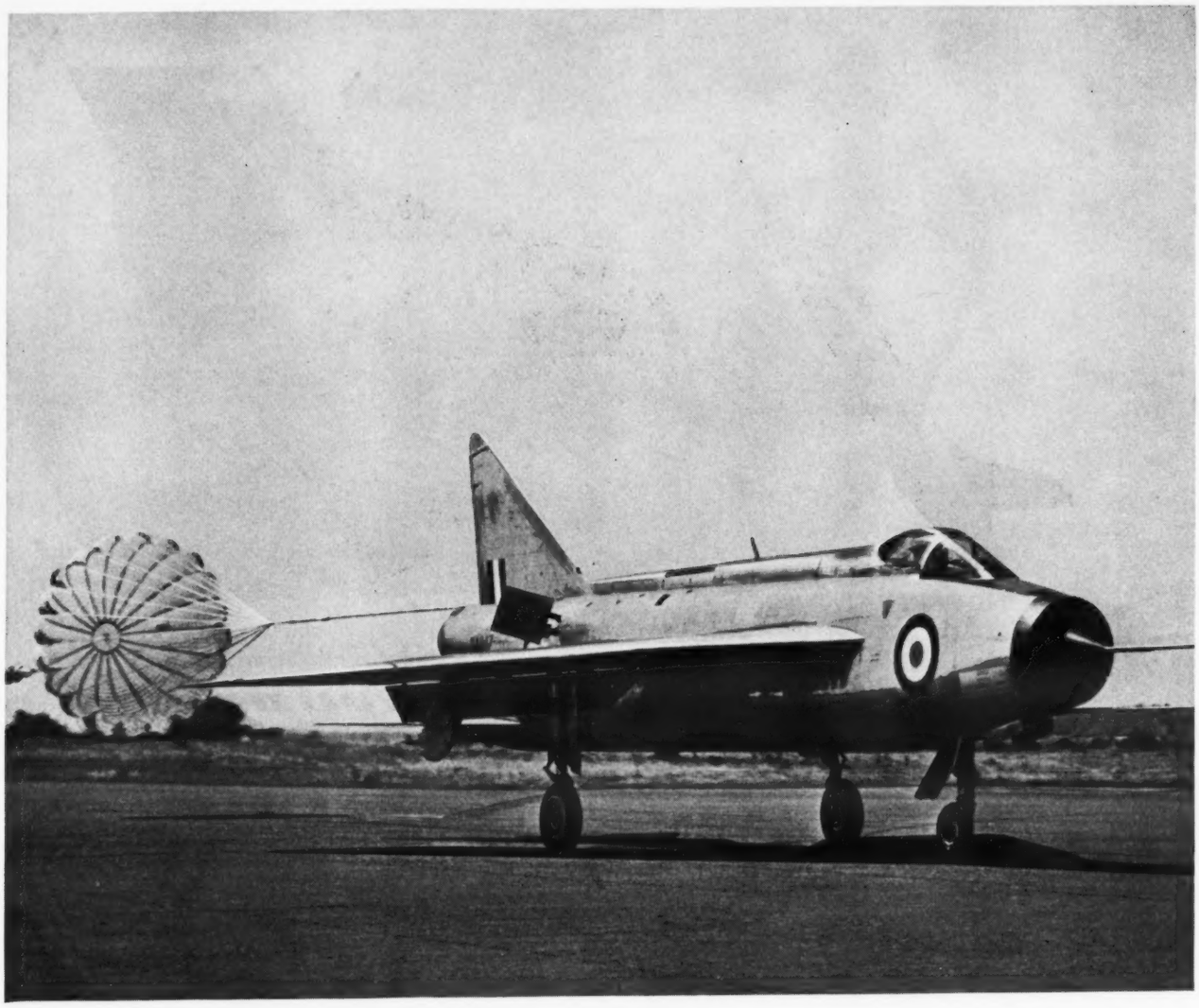

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Thanks to low speed wind-tunnel and other development work at Warton, the P.1. is so easily handled that it is regularly landed and brought to rest in not much more than half the length of the present RAF fighter runway.

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Foreword by the Secretary of the American Air Force

THE HON. JAMES H. DOUGLAS, SECRETARY OF THE AIR FORCE,

is a man of warm and open personality, also interested in sport, being a prominent amateur golfer. A graduate of Princeton and Harvard Law School he practised in Chicago from 1925 until 1932, when he was named Assistant Secretary of the Treasury. During the war he served as Deputy Chief of Staff of the Air Transport Command. After the war he returned to law practice and became a Director of many companies including American Airlines. In 1953 he was recalled to Government service and appointed Under Secretary of the Air Force; in the summer of 1957 at the age of 58 he became Secretary of the Air Force in succession to Donald A. Quarles when the latter was made Deputy Secretary of Defense.

The Editors

It is a privilege to introduce you to the United States Air Force through the pages of Interavia. *Both in the pictures and in the articles that follow you will see the great advances that we have made since the modest beginnings of the United States Air Force as part of the Signal Corps of the Army just fifty years ago.*

In reading this issue of Interavia, *you realize that the men and the planes of the United States Air Force comprise not only American air power but also a central part of the air power of the free world.*

With the support of our allies, our Air Force operates from free world bases around the globe. It is reinforced by the men and the planes of the free nations of the world. It takes great pride in being a member of this international air power team, and its purpose is the security and peace of the free world.

James H. Douglas

Golden Jubilee of the American Air Force

The birth and development

Even by American standards it was a stupendous ceremony . . . on August 1st, 1957, two thousand guests—flying men, engineers, scientists and industrialists—packed the round tables of the Sheraton-Park Hotel's vast ballroom to celebrate the Golden Anniversary of American Air Power. On stage, framed in a golden border, 29 VIPs symbolized the fifty years history of United States military aviation; regarded with awe by an audience to some of whom at least even the names were unfamiliar.

Exactly 50 years earlier on August 1st, 1907, an Aeronautical Division, under command of Captain Charles de Forest Chandler, had been established in the office of the U. S. Army's Chief Signals Officer, to be responsible for military aviation matters. This then had been the beginning.

The immediate developments gave no forecast of the emergence of an air arm as we know it today, except that in 1908 the War Department bought the first military aircraft from the Wright Brothers at a cost of $30,000. It is no secret that the service life of this machine was exceptionally short; after only a few days, on September 17th, 1908, it crashed, killing the U. S. Army's first military pilot, Lieutenant Thomas E. Selfridge, and seriously injuring Orville Wright.

At that period there was no such thing as an aircraft industry but nevertheless plans were considered for the provision of equipment for this first nucleus of air power: balloons, airships and a few aircraft.

Came the first World War, America joined the Western allies and, under pressure from the French, undertook an expansion of her air arm; in June 1917 an appropriation of $640 million was authorized to provide for a force of 5,000 aircrew, 50,000 ground personnel and 4,500 aircraft to be available by early 1918. By present-day standards a very modest expenditure, but, for the times, the amount was staggering. Brig. Gen. William L. Kenly was appointed the first Chief of Air Service, A. E. F. in France, responsible for the overall organization of all the Army air activities. Concurrently research into all fields of aeronautics commenced in the U.S.A.

The spring of 1918 saw the first American war successes and the emergence of the first New World "aces", Eddie Rickenbacker and Douglas Campbell. The autumn offensive of the same year found Brig. General William Mitchell directing the air operations against the German forces, the same "Billy" Mitchell who, after the war, successfully demonstrated the bombing and sinking of captured German warships, and embarked upon a long and bitter one-man crusade in an attempt to convince his contemporaries of the vast possibilities of air power.

The war faded into the past but the conception of an air arm gradually gained ground, and in 1926 the establishment of the Air Corps within the U. S. Army was authorized by Congress; at the same time the appointment of an Assistant Secretary of War for Air was created. Army Reserve Captain Charles A. Lindbergh's record North Atlantic crossing on May 21st, 1927 had a profound impact.

It will not be forgotten that for many years, right up to the time of the second World War, the U. S. Navy's air force continued to be the favoured sister, both in finances and power, of American service aviation, a position not to be relinquished without some friction.

The embryonic Air Force took a big step towards independence from U. S. Army control with the establishment of its own command in March, 1935, the General Headquarters Air

USAF

Force at Langley Field. The same year saw the introduction of the four-engine strategic bomber, the B-17 *Flying Fortress*, which was to play such a decisive role in the second World War some years later.

With the approach of the war the Army Air Force was authorized a strength of 6,000 aircraft, a record figure for peacetime and, for the first time in history, could see the way clear to the realization of the conception of air power strategic planning; appointed chief was Major General H. H. Arnold, the man whose name is engraved in the annals of the Air Force.

Further development followed in leaps and bounds; the North Africa landings proved the airarm to be as indispensible as the ground and naval forces. A new science arose; air logistics.

The year 1944 saw preliminary decisions on the future organization of these air forces which were still subordinated to the U. S. Army: 79,908 first line aircraft, 2,411,294 officers, enlisted men and auxiliary personnel. An organization of this size could no longer be regarded as a secondary force. With victory in the West, and the dropping of the first A-bomb on Hiroshima, the Air Force contribution was officially acclaimed, and the Commander, General "Hap" Arnold, became an outstanding figure in the Pentagon.

His successor, General Carl Spaatz, gathered the harvest; on September 18th, 1947, the United States Air Force was established as an independent arm of the U. S. Armed Forces, alongside the Army and Navy. The birth pangs of the U.S.A.F. were over.

This somewhat arbitrary listing of dates, facts and events serves to underline the words of James H. Douglas, present Secretary of the Air Force, in his introduction to this issue . . . "the great advances that we have made since the modest beginnings of the U.S.A.F. as part of the Signal Corps of the Army". Because . . . and let there be no doubt—even including Görings *Luftwaffe*, never before has the world witnessed so mighty a centralization of military power as that represented today by the U.S.A.F. It matters little whether, on August 1st, 1957, the Air Force celebrated its fiftieth—or more precisely—only its tenth anniversary.

Before turning to the descriptions of the "Sword, Shield and a Mailed Fist", it is perhaps permissible to venture on to somewhat delicate ground and to speculate a little on what the near future may hold for this world decisive instrument of power.

Quo vadis?

During the week July 28th to August 4th Washington was the scene of a truly impressive celebration. Thousands and thousands of visitors participated in the Air Force Association's Golden Anniversary Convention and Airpower Panorama, filled the streets of the capital, and were proud to be associated, however modestly, with the U.S.A.F. But speeches by the responsible leaders on this occasion hinted that, despite apparently clear skies, thunder clouds were massing on the horizon.

The gold-bordered "Anniversary Portrait" of the men and women symbolizing the history of United States air power presented at the Golden Jubilee of the American Air Force.

From left to right, front row: Dr. Theodore von Karman, M/Sgt. Horst Tittle, Gen. Nathan F. Twining, Brig.Gen. Frank P. Lahm, Air Cadet Dennis R. Lafarlette, Mrs. Henry H. Arnold, Gen. Carl A. Spaatz, Maj. Charles E. Yeager; second row: Brig. Gen. Erik H. Nelson, Lt.Col. James Jabara, Gen. George C. Kennedy, Miss Jacqueline Cochran, Gen. Thomas D. White, Capt. Edward Rickenbacker, Col. Oakley Kelly, Col. John Macready; third row: Col. Francis S. Gabreski, Miss Edna M. Adkins, Senator Stuart Symington, Hon. James H. Douglas, Maj.Gen. Claire Chennault, Maj. James G. Gallagher; top row: Col. Paul W. Tibbets, Col. Bert Balchen, Lt.Gen. William H. Tunner, Brig. Gen. Thomas DeWitt Milling, J. H. "Dutch" Kindelberger, Gen. O. P. Weyland, Roscoe Turner.

"It distresses me, of course, that we have to postpone or eliminate certain programs, but I am not apprehensive about our ability to provide a great Air Force. The resources still available will permit the Air Force's highest peacetime expenditure, except for 1957, and one only slightly less than that peacetime high . . . Present effective weapons must never be sacrificed for new weapons until the new ones are fully proven . . .We must continue building manned aircraft of ever higher performance and we must reach out for missile capability . . . we must never be so preoccupied with our own Air Force that we forget our responsibility for cooperating with the air forces of our allies . . . Can we do all these things and yet keep expenditures at a level rate? We can, unless inflation increases". These extracts from the Secretary of the Air Force's address cannot be ignored. The Minister was taking stock of the problems facing not only his subordinates, the flying personnel of the U.S.A.F., but also industry; it seems that these problems are not military in origin, but are rather of a technical, or more correctly, political and economic nature. To put it bluntly, the outsider cannot help occasionally having the impression that some of the Eisenhower Administration's political moves, and their attendant economic measures, may dislocate not only the U.S.A.F.'s carefully developed plans, but also those of the entire American armed forces; in spite of the fact that until 1956 these plans were widely acclaimed as the only possible salvation in the face of continuing threats of war.

To look back, on August 8th, 1946, the Consolidated-Vultee B-36 heavy bomber made its first flight, after years of development work, and, in the final version, powered by ten engines. In the view of the American services this was the achievement of the first intercontinental bomber, with an operational range of 10,000 miles; it was described as capable of delivering an A-bomb to targets anywhere in the world. This became the instrument of a new strategy, the perfect deterrent weapon, capable of supressing any threats of a global conflagration and of finally removing any threat of a new world war. The basic concept was born, but further developments were put in hand. A six-jet heavy bomber was developed for the same role as the B-36, for shorter ranges but reaching greater altitudes and speeds, and capable of operating from any of the bases which American statesmen and the armed forces had meanwhile established around Asia. A further step was achieved with the production of the eight-jet Boeing B-52 which was hailed as the embodiment *par excellence* of the deterrent policy. In the background was the further reassurance of a successor in the form of the Convair B-58 *Hustler*, tomorrow's super-bomber.

Supplementing this strategic "bomber armada" is every possible piece of equipment which modern engineering is capable of producing: jet tankers for even further increases in bomber ranges; escort fighters; interceptors; reconnaissance aircraft; anti-submarine aircraft; radar installations for warning and operational control; and everything else man can devise.

The U.S.A.F. is at the peak of its power. It has been the *alpha* and *omega* of the entire Western policy for peace and war, and behind its shield alliances have been formed which, if the worst should happen, would ensure an immediate storm of crippling blows against any possible aggressor. This then was the concept which the first Secretary of the Air Force W. Stuart Symington had worked out, set up and defended to the extreme. Air Power as never before seen! This concept held good until 1956.

In that year it became evident that the U.S.A.'s only potential enemy, the Soviet Union, had also

not been sleeping. It was realized, especially after the Soviet Aviation Day in Moscow in June 1956 —attended also by A. F. General Nathan F. Twining, today Chairman of the Joint Chiefs of Staff—that the Russian armament program had pursued objectives similar to the American. The Soviet Union now also had intercontinental bombers, tankers, super powerful jet engines, interceptor and escort fighters and, naturally, rockets and guided missiles in preparation or under construction. The effect on the Americans was much the same as when, five years previously, they had learned with pained surprise that the monopoly of atomic armament had escaped them overnight, and was shared with a potential enemy.

The fact that another country now dared to challenge United States technical superiority really put the cat among the pigeons—at any rate in the State Department. Nobody appeared to be prepared for this development.

The defense policy based on the "great deterrent", let us call it the "Symington Plan", was devalued. Since May 1956 there have been persistent whispers in the capitals of Europe of a new "Radford Plan", which had been drawn up by the then Chairman of the Joint Chiefs of Staff, Admiral Radford, perhaps under some political and economic pressure. Certain anxieties arose among the U.S.A.'s allies who, rightly or wrongly, thought they could detect in this plan a tendency towards isolationism: the fall-off in common effort, reduction of interest in Europe, abandonment of further conventional armaments, reduced emphasis on manned aircraft—in particular on fighters. What seemed to be the American attitude? That it is impossible to produce and exploit every conceivable weapon; a country attempting to possess armaments both for today and tomorrow can face economic ruin; and, as a last resort, there is always the H-bomb for use if and when the vital interests of the U.S.A. are seriously menaced.

The details of the Radford Plan have never been released in simple concrete form. However, it has never been denied that certain parts of the American forces might be pruned, or that some formations overseas might be reduced or withdrawn. Admittedly the global deterrent policy still holds good, but there is a feeling in some quarters that this policy is no longer to be closely integrated with the interests of the smaller nations.

Such was roughly the position when Britain—apparently following the American lead—published the now historic White Paper and a new assessment of the armaments position; France also began thinking tentatively about switching to new weapons although still heavily committed in the North African conflict; and—last but not least—West Germany finally announced that she was launching a rearmament program which, in fact, is the prerequisite for the realization of full sovereignty. Now a wide variety of staff officers and military writers are engaged in a guessing game as to what type of armaments should be laid down for the West following the apparent realignment of American policy. American writings sometimes give the impression that the new economic theories have almost succeeded in confusing the Pentagon experts as to the formulation of a new strategy. All that is revealed by official statements, however, is that production of what has so far been regarded as the main instrument of American deterrent policy, the intercontinental Boeing B-52, will be stretched out or slowed down; that the widely publicized successor, the *Hustler*, is not yet in operational service; that the supersonic fighters, which only a year ago were acclaimed as the answer to all problems, are being overtaken by events; and that the planners would prefer to give up manned aircraft altogether to concentrate on a fully automatic intercontinental missile with H-warhead as the final deterrent weapon and thus simplify and reduce costs on the entire armaments program.

The Russian announcement in the late summer of 1957 that the Soviet Union possessed a missile able to reach and destroy any point in the world, was the final straw to break the back of ten years' ordered planning. Since 1941 the world had witnessed in America the build up of an aviation industry never before achieved or envisaged by any other nation, at a cost of thousands of millions of dollars; in 1946, when it appeared that a lasting peace had been won, this vast armament industry was virtually put into mothballs, only to be speedily reactivated in 1950, at the cost of further millions, with the outbreak of war in Korea and the realization by the West, that Russia had been following a completely opposite policy. What are the industry's prospects today?

*

James H. Douglas, brilliant and distinguished Secretary of the Air Force, spoke in his usual cautious manner about his problems and also about his hopes for the future but, as Minister responsible for the Air Force, he is naturally obliged to conform to an overall American Government policy. The U.S. Air Force is undoubtedly an outstanding achievement and embodiment of global power, but can the Generals, technicians, flyers, military planners and industrialists maintain this position in the face of political developments? In the last instance they also are only the instrument of State Department policy.

The State Department makes no attempt to conceal its views. In the October issue of *Foreign Affairs*, organ of the State Department, Secretary John Foster Dulles has undertaken a detailed review of American defence policy in general, and of overall American policy vis-à-vis her allies, in particular.

In this article the Secretary of State focuses attention on the fact that the nature of atomic weapons may undergo a fundamental change in the future. In the last decade the security of the United States and of her free-world allies has been based on the availability of American strategic atomic weapons, the use of which would inherently imply the acceptance of the destruction of large areas of the civilized world. The future may bring a shift in emphasis within the strategy of deterrence from reliance upon deterrents of vast, indiscriminate power towards the employment of nuclear weapons whose destructiveness can be confined substantially to predetermined targets and which can be "so mobile, or so placed, as to make military invasion with conventional forces a hazardous attempt. For example, terrain is often such that invasion routes can be decisively dominated by nuclear artillery. Thus, in contrast to the 1950 decade, it may be that by the 1960 decade the nations which are around the Sino-Soviet perimeter can possess an effective defense against full-scale conventional attack and thus confront any aggressor with the choice of failing or himself initiating nuclear war against the defending country".

Interavia is not seeking here to argue the case as to whether or not the United States is tending towards a degree of withdrawal from NATO, SEATO or other mutual defense agreements; the only question of interest in connection with this special USAF issue is whether or not Secretary of State Dulles' remarks can be interpreted as advocating a weakening of the USAF.

It is obvious that any such proposal by the State Department would inevitably arouse serious disquiet among the allies of the United States, for whom the deterrent air power of the USAF is still clearly a corner stone of all defense planning.

Recently the periodical *Occident/Western World* organized a discussion of prominent European and American politicians at the "Cercle Interallié" in Paris, on the theme: *New weapons and disarmament; the strategic and political effects on NATO, and on the development of relations with the Soviet Union.* Amongst other participants in this conference were NATO's Secretary General Paul-Henri Spaak, France's André François-Poncet, Holland's Paul van Zeeland and U. S. Senators Kefauver and Cooper; the Europeans unanimously and emphatically urged that no action should be taken to reduce the present western deterrent potential, and that the USA, in the deployment of her forces for defense of the West, should not differentiate between "global" and "regional" conflicts.

But to return to the main question: Does Secretary of State Dulles, as responsible leader of American foreign policy, advocate a reduction in the power of the USAF? By inference he does not, for his quoted remarks continue: "the tables may be turned, in the sense that, instead of those who are non-aggressive having to rely upon all-out nuclear retaliatory power for their protection, would-be aggressors will be unable to count on a successful conventional aggression, but must themselves weigh the consequences of invoking nuclear war".

In other words, in either case Dulles apparantly still finds himself obliged to admit the possibility of an unlimited atomic war. If this is indeed the case, then he cannot logically be in favour of any suggestion to restrict the efficiency of the only possible instrument, the USAF.

In the late summer of 1957 Russia informed the western world that she now possesses missiles capable of reaching any part of the world, and destroying any given target. In October, the Soviet Union launched the first earth satellite... hardly the appropriate moment to propose a reduction in American air power.

E.E.H.

USAF

Organization of the United States Air Force

The United States Air Force, with 900,000 men and 25,000 aircraft on 288 installations in twenty-four different countries, is the largest peacetime military power of its kind in the history of the free world. Despite its size and the different missions it has to perform, it operates efficiently on an organizational set-up that is simple and compact.

Top man in the Air Force, directly under Commander-in-Chief President Dwight D. Eisenhower and his Secretary for Defense, Neil McElroy, is Secretary of the Air Force, James H. Douglas. Aided by Under Secretary Malcom A. MacIntyre and a staff of assistant civilian secretaries responsible for Financial Management, Manpower, Materiel, and Research and Development, he directs all Air Force programs and policies. Filling out his staff is a Special Assistant for Installations, an Administrative Assistant who caters to his official demands, a Requirements Review Board which keeps him up to date on the needs of the Air Force, the General Counsel who supplies legal advice, an Office of Legislative Liaison which coordinates Air Force activities with Congressional legislation, and the Office of Information Services.

Top military man under the Secretary is the Chief of Staff of the Air Force, General Thomas D. White. As principal adviser on air power to the President, the Secretary of Defense, and the Secretary of the Air Force, General White carries out their orders and serves as a member of the Armed Forces Policy Council and the Joint Chiefs of Staff. His right hand man, helping him to perform these duties, is the Vice Chief of Staff, General Curtis E. LeMay.

Lending close support to the Chief and Vice Chief are the Assistant Chiefs of Staff for Reserve Forces, Guided Missiles, and Intelligence, the Inspector General, the Surgeon General, and the Judge Advocate General.

General White's Air Staff is made up of the Deputy Chiefs of Staff for Personnel, Operations, Materiel, Development, Plans and Programs, and the Deputy Chief of Staff, Comptroller. Each of the Deputy Chiefs is responsible for the requirements of the Air Force in his particular field.

From the Secretary and the Chief of Staff at Headquarters level, the organization line leads to the sixteen major commands, which can be broken down into three categories.

THE COMBAT COMMANDS: *Strategic Air Command,* capable of world-wide strategic bombardment, is the Air Force's offensive air arm. Composed of the Second, Eighth, Fifteenth, and Sixteenth Air Forces, its primary weapon is the B-47 medium bomber and the B-52 heavy bomber. *Air Defense Command,* charged with the air defense of the United States, patrols the defensive perimeters with supersonic Century Series fighter aircraft. *Tactical Air Command,* its Ninth, Eighteenth, and Nineteenth Air Forces utilizing the B-66, the B-57, the C-119, and numerous fighter aircraft, provides air support for ground and naval forces.

THE SUPPORT COMMANDS: *Air Materiel Command,* the Air Force supply depot, has charge of procurement and maintenance of all Air Force equipment. *Air Research and Development Command* has the big job of finding better ways for the combat commands to perform their missions. *Air Proving Ground Command,* with 15,000 square miles of ranges in the Gulf of Mexico, puts new equipment and operational techniques to test to find out if they can stand up in actual use. *Air Training Command* trains basic airmen, ground crews, pilots, navigators, advanced crews, and administrative personnel. *Air University,* concerned with higher education of Air Force officers, operates the Air War College, the Air Command and Staff School, the U.S.A.F. School of Aviation Medicine, the U.S.A.F. Institute of Technology, the U.S.A.F. Extension Course Institute, and the Air Force Reserve Officers Training Corps program. *Continental Air Command* supervises the Reserve Forces and the Air National Guard. *Headquarters Command* is the administrative command which services U.S.A.F. headquarters in the Pentagon. *Military Air Transport Service,* which operates on a world-wide basis, provides transportation and airlift for the Army, Navy, and Air Force. *U.S.A.F. Security Service* safeguards intelligence and security activities of the Air Force.

THE OVERSEAS COMMANDS: The mission of an overseas command is to maintain a combat capability in its assigned area. *United States Air Forces in Europe,* with the Third Air Force in England, the Twelfth Air Force in Germany, and the Seventeenth Air Force in French Morocco; the *Pacific Air Forces,* with the Fifth Air Force in Japan, the Seventh Air Force in Hawaii, and the Thirteenth Air Force in the Philippines; the *Alaskan Air Command* and the *Caribbean Air Command* are the commands carrying out that mission in the various parts of the world.

Below the command level, the organization fans out rapidly into separate Air Forces, divisions, and wings. Each wing is composed of groups, each group of squadrons, and each squadron of flights, right down to the lowest ranking individual who has just entered basic training.

Each one of the Air Force's 900,000 men, whether he is a mechanic servicing a plane in North Africa, a tactical officer at a training field in Texas, or a four-star general in the Pentagon, has a job in an organization that keeps the Air Force working smoothly in its effort to maintain world peace.

The United States Joint Chiefs of Staff: (left to right) General Thomas D. White, Chief of Staff, USAF; General Maxwell D. Taylor, Chief of Staff, U.S. Army; General Nathan F. Twining, Chairman; Admiral Arleigh A. Burke, Chief of Naval Operations; and General Randolph McC. Pate, Commandant U.S. Marine Corps.

Special A
for Intel
Frederick

Secretary of the Air Force
Hon. James H. Douglas

Chairman of the Joint Chiefs of Staff
Gen. Nathan F. Twining

Supreme Allied Commander, Europe
Gen. Lauris Norstad

C.-in-C., North American Air Defense Command
Gen. Earle E. Partridge

Special Assistant for Installations
John M. Ferry

Administrative Assistant
John J. McLaughlin

Office of Legislative Liaison
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Assistant Secretary of the Air Force, Materiel
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Lt. Gen. Elmer J. Rogers, Jr.

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Maj. Gen. Dan C. Ogle

Judge Advocate General
Maj. Gen. Reginald C. Harmon

Chief of Staff of the Air Force
Gen. Thomas D. White

Assistant Chief of Staff
Maj. Gen. Jacob Edward Smart

Vice Chief of Staff
Gen. Curtis E. LeMay

Assistant Chief of Staff, Reserve Forces
Maj. Gen. Richard A. Grussendorf

Assistant Chief of Staff, Guided Missiles
Brig. Gen. Charles M. McCorkle

Assistant Chief of Staff, Intelligence
Maj. Gen. Millard Lewis

Deputy Chief of Staff, Personnel
Lt. Gen. Emmett O'Donnell, Jr.

Deputy Chief of Staff, Operations
Lt. Gen. William H. Tunner

Deputy Chief of Staff, Materiel
Lt. Gen. Clarence S. Irvine

Deputy Chief of Staff, Development
Lt. Gen. Donald L. Putt

Deputy Chief of Staff, Plans and Programs
Maj. Gen. John H. Gerhart

Comptroller of the Air Force
Lt. Gen. Manuel J. Asensio

COMBAT COMMANDS

Strategic Air Command
Gen. Thomas S. Power

2d Air Force
8th Air Force
15th Air Force

Tactical Air Command
Gen. O. P. Weyland

16th Air Force
3th Air Division
5th Air Division
7th Air Division

Air Defense Command
Lt. Gen. Joseph H. Atkinson

9th Air Force
18th Air Force
19th Air Force

60 Combat Wings

SUPPORT COMMANDS

Air Materiel Command
Gen. Edwin W. Rawlings

Air Research and Development Command
Lt. Gen. Samuel E. Anderson

Air Proving Ground Command
Maj. Gen. Robert W. Burns

Air Training Command
Lt. Gen. Charles T. Myers

Military Air Transport Service
Maj. Gen. Joseph Smith

Headquarters Command
Maj. Gen. Reuben C. Hood, Jr.

USAF Security Service
Maj. Gen. Gordon A. Blake

Air University
Maj. Gen. Dean C. Strother

Continental Air Command
Lt. Gen. William E. Hall

1st Air Force
4th Air Force
10th Air Force
14th Air Force

OVERSEAS COMMANDS

U.S. Air Forces, Europe
Gen. Frank F. Everest

3d Air Force
12th Air Force
17th Air Force

Pacific Air Forces
Gen. Laurence S. Kuter

5th Air Force
7th Air Force
13th Air Force

Alaskan Air Command
Lt. Gen. Frank A. Armstrong, Jr.

Caribbean Air Command
Maj. Gen. Truman H. Landon

USAF

Sword, Shield... and a Mailed Fist

THE USAF's COMBAT COMMANDS

Anyone seeking to understand the organizational set-up of the globe-encircling military power entitled the "United States Air Force", finds himself confronted with a bewildering array of administrations, staffs, major commands, air forces and independent air divisions. The picture becomes clearer, however, if he initially ignores the Air Force Command and Staff and the various support commands for training, materiel, research and transport services, and concentrates on the units which would be required to go into action immediately upon outbreak of an armed conflict. These are the so-called combat commands and can be grouped as follows, according to their main tasks.

- **TACTICAL AIR FORCES IN THE U.S.A. AND OVERSEAS:**

① **Tactical Air Command (TAC),** with headquarters at Langley Air Force Base, Virginia;

② **United States Air Forces in Europe (USAFE),** with headquarters at Wiesbaden, Germany;

③ **Pacific Air Forces,** with headquarters at Hickam AFB, Oahu, Hawaii;

④ **Alaskan Air Command,** with headquarters at Elmendorf AFB, Alaska;

⑤ **Caribbean Air Command,** with headquarters at Albrook AFB, Balbao, Panama Canal Zone.

- **AIR DEFENSE FORCES FOR NORTH AMERICA:**

⑥ **Air Defense Command (ADC),** with headquarters at Ent AFB, Colorado;

⑦ **Continental Air Command** (the Air Force's Reserve organization), with headquarters at Mitchel AFB, New York.

- **STRATEGIC AIR FORCES:**

⑧ **Strategic Air Command (SAC),** with headquarters at Offutt AFB, Nebraska;

⑨ **16th Air Force (under SAC),** with headquarters at Madrid, Spain;

⑩ **3rd SAC Air Division,** with headquarters on Guam, Marianas Islands;

⑪ **5th SAC Air Division,** with headquarters in Morocco;

⑫ **7th SAC Air Division,** with headquarters in Great Britain.

The most important of these twelve combat commands are those stationed within the United States Zone of the Interior—TAC, ADC and SAC—which bear responsibilities beyond their more obvious competencies. *Tactical Air Command,* for example, is responsible for field training and the provision of crews and aircraft for the USAF's four overseas tactical commands. *Air Defense Command (ADC)* would in wartime assume command of the fighter units of Continental Air Command and other Reserve organizations. And *Strategic Air Command (SAC)* has retained direct command over three overseas air divisions and one air force.

Tactical Air Command's coat of arms is a *sword,* and Air Defense Command's an *eagle* spreading its wings like a shield over the American Continent. Strategic Air Command's symbol is a *mailed fist* gripping a cluster of lightning flashes.

These heraldic arms reveal a basic logic: whereas the sword of TAC indicates merely an extension of American diplomacy, with the principal task of preventing or rapidly settling local conflicts, SAC's mailed fist is so to speak the United States' last resort... in the event diplomacy should fail, and a global war break out. The third partner, ADC, has the mission of keeping the skies above the homeland clear of enemy raiders. It is the shield-bearer of the American nation.

The headquarters of the USAF's three combat commands and overseas commands.

TACTICAL AIR COMMAND

Interavia's two representatives, Harry Tennant, Editorial Director, U.S.A., and Dr. H. Rieck, Chief Technical Editor, began their tour of the Air Force's combat commands at *TAC Headquarters, Langley Field,* Virginia.

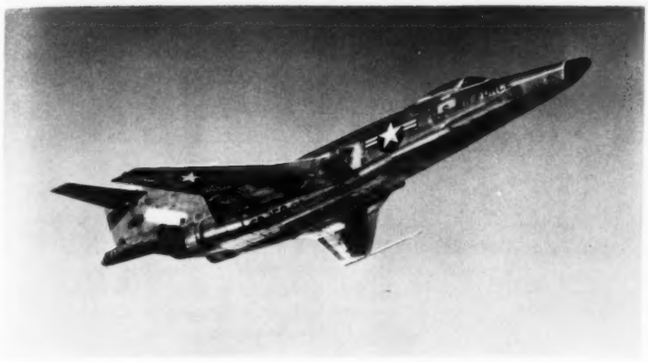
Only one hour by air from Washington, this USAF base lies on the narrow neck of land which divides the mouth of the James River from Chesapeake Bay. Approaching air travellers can clearly recognize the giant wind tunnels and laboratories of the National Advisory Committee for Aeronautics, which has its oldest and biggest installations here. Lined up on the airfield were some two dozen Martin B-57 bombers and a good dozen Boeing KB-50 tankers, as well as a squadron of Convair F-102A all-weather fighters. It was learned later, however, that these fighters did not belong to TAC, but to a visiting Air Defense Command unit.

Tropical heat brooded over the base. Most of the officers and men worked in summer uniform —shorts, knee stockings, short-sleeve shirts with open necks—and the offices and working quarters were pleasantly air-conditioned. Colonel Le Bailly and Lieutenant Colonel Smedley of the Office of Information Services received the visitors and described for them the tasks, organization and resources of TAC:

- **TAC's MISSIONS:** tactical support of ground troops in any local or global war and execution of independent air operations. Detailed tasks are as follows:

1 – **Ensuring air superiority over the combat zone** (day fighters and long-range escort fighters);

2 – **direct support of the ground fighting** (fighter-bombers and tactical all-weather bombers);



Tactical reconnaissance (McDonnell RF-101A *Voodoo* photographic reconnaissance aircraft) . . .

. . . and the maintenance of air supremacy over the combat zone (North American F-100 day fighters) are the missions of Tactical Air Command.

3 – **interdiction,** i.e., cutting the enemy's supply lines (fighter-bombers and tactical all-weather bombers);

4 – **tactical reconnaissance** (armed and all-weather reconnaissance aircraft);

5 – **airlift** for paratroopers, airborne troops, arms, equipment and supplies into the combat zone (assault transports);

6 – **autonomous air operations** by Composite Air Strike Forces consisting of bomber, fighter, tanker and transport units.

● **COMMAND:** TAC Commander is **General O.P. Weyland,** who controls three Air Forces under Major General Robert M. Lee (9th Air Force), Major General Chester E. McCarty (18th Air Force) and Brigadier General Henry Viccellio (19th Air Force).

● **STRENGTH:** more than 60,000 officers, N.C.O.s and enlisted men.

● **OPERATIONAL UNITS:** nine day fighter wings and groups; nine fighter-bomber wings and groups; three bomber wings and groups; two reconnaissance wings and groups; five transport wings (18th Air Force); one Composite Air Strike Force (19th Air Force).— Each full combat wing comprises two groups of four squadrons (18 aircraft per squadron); two combat wings are combined to form an air division.

● **EQUIPMENT:**

- North American F-100 and F-86H day fighters
- North American F-100 and F-86H, and Republic F-84F fighter-bombers
- Martin B-57 and Douglas B-66 bombers
- Republic RF-84F and McDonnell RF-101 armed reconnaissance aircraft
- Martin RB-57 and Douglas RB-66 all-weather reconnaissance aircraft
- Martin TM-61 tactical missiles
- Fairchild C-123 and Lockheed C-130A assault transports (TAC's heavy Douglas C-124 transports were recently handed over to MATS)
- Boeing KB-50 tanker/transports.

TAC's day fighters are armed with cannon, unguided rockets and guided missiles (e.g., *Sidewinders*). Its fighter-bombers and tactical all-weather bombers may carry a wide variety of military loads, including tactical atomic bombs. The reconnaissance aircraft are equipped with up to seven cameras, and the assault transports can accommodate 60 or 90 fully-equipped airborne troops.

● **NEW FLYING EQUIPMENT:**

- Republic F-105 supersonic fighter-bombers.

With justifiable pride TAC's Information Service officers also described the first intercontinental exercise carried out by a Composite Air Strike Force, which was organized by the 19th Air Force (Brigadier General H. Viccellio) last autumn under the name of "Operation Mobile Baker". 16 North American F-100 *Super Sabre* day fighters, 16 Republic F-84F *Thunderjet* fighter-bombers, 4 Republic RF-84F *Thunderflash* armed reconnaissance aircraft and 4 Douglas B-66 all-weather bombers crossed the North Atlantic, in groups of 8 aircraft, from Newfoundland to North Africa (roughly 2,500 nautical miles non-stop) and were refuelled in flight by Boeing KB-50 tankers, by the probe and drogue method. The whole force thus numbered 40 combat aircraft, plus 6 tankers and 3 transports, with crews totalling 198 officers and men. As the

Interview

Major General John D. Stevenson

Director of Plans,
Tactical Air Command,
Langley AFB, Virginia.

Interavia: General Thomas D. White, Chief of Staff of the Air Force, recently stated in Washington that the Air Force structure is constantly under adjustment to meet changing times. He added: "We have pared the Tactical Air Forces. We may have to pare them further." —Will not the latest Defense budget cut have a far-reaching effect on Tactical Air Command's resources and planning?

Major General Stevenson: The cut will naturally have some effect on our planning, but nothing I could term as "far-reaching". We have been increasing our capabilities in the nuclear weapons field; we are introducing new missiles into our units; we are doing a lot of air refueling work with traditionally short-range aircraft such as our fighters and fighter-bombers. The Composite Air Strike Force is an entirely new military concept for the multi-purpose Tactical Air Command. By its very existence, its capability for both teamwork with the Army and independent air operations via its Composite Strike Forces, TAC can quickly settle local conflicts anywhere and thus is a deterrent to general war. Small numbers, rapidly deployed, are better than large numbers late. And as we have to use atomic weapons in order to compensate for our lacking in quantity, one sortie today will do what took perhaps four sorties in Korea or one hundred sorties in World War II. We can strike anywhere, as the normal range of our airplanes can be extended at will by aerial refueling, but do not forget that close support of our own or friendly Armies on the battlefield, although highly publicized, is not the only role of Tactical Air Command. Our primordial task is to win air superiority over the enemy. Our Army has never had to fight against opposing air superiority and as far as we are concerned, never will.

The range of Tactical Air Command's Composite Air Strike Forces can be extended at will by in-flight refueling. A Boeing KB-50 tanker refueling a Douglas B-66 twin-jet bomber and two North American F-100 escort fighters.

Rapidly movable GCA landing aids such as pictured here are essential to ensure mobility of Tactical Air Command units.

USAF

Fairchild C-123 TAC assault transports (each capable of carrying 60 airborne troops) at Nome, Alaska.

Lockheed C-130A assault transport (for 90 airborne troops) on skis.

combat aircraft immediately flew on from North Africa to the USAF bases at Landstuhl and Spangdahlem in Germany, and Aviano in Italy, a total of 5,200 nautical miles was covered in formation flight in three flying days, thus giving convincing proof of *Tactical Air Command's global mobility*.

*

As *Interavia*'s reporters left Langley Field, two North American F-100 *Super Sabre* fighter-bombers were wheeling overhead. They were practising a perfectly unspectacular aerobatic figure, consisting of a half loop followed by a half roll... TAC experts have discovered that this is the best method of dropping tactical atom bombs "over the shoulder", without running into the fireball.

AIR DEFENSE COMMAND

As "shield-bearer" for the American nation, Air Defense Command must serve two masters at one time: from the administrative and materiel points of view it is subordinate to the Chief of Staff of the Air Force, while all operational orders for the flying units come from the Commander-in-Chief of North American Air Defense Command (NORAD), the successor to Continental Air Defense Command (CONAD), and his command organization, by direct delegation from the Joint Chiefs of Staff in Washington and the Canadian Government.

The reason for this division of responsibilities is the fact that the intercontinental near-sonic bombers of a potential enemy could be intercepted only through the strictest integration of available detection and identification facilities in North America on the one hand, and the weapons of all services on the other. However, only the Air Force can judge what pilots, aircraft and airborne weapons should be used to protect the homeland. Incidentally, the Army units (primarily rocket and anti-aircraft batteries) and Navy units attached to NORAD are also under operational command of CINCNORAD (Commander-in-Chief, NORAD), but are administered by their own Army or Navy Staffs.

The present commander of ADC is *Lieutenant General Joseph H. Atkinson,* while *General Earle E. Partridge,* an Air Force four-star general, is Commander-in-Chief of NORAD. The latter's Deputy is Air Marshal C. Roy Slemon, RCAF. General Atkinson's two U.S. "colleagues" are Lieutenant General Stanley R. Mickelsen (commander of the U.S. Army Air Defense Command) and Rear Admiral Walter F. Rodee (Commander, Naval Forces, NORAD). The headquarters of ADC—and of NORAD—are located in a barrack-like group of buildings at Colorado Springs, Colorado, which is known as *Ent Air Force Base,* but is miles away from the nearest airfield.

*

Colorado Springs lies in the western half of the United States, roughly 1,560 nautical miles by air from New York and at the foot of one of the main chains of the Rocky Mountains, rising to around 14,000 ft. Eastward, the sparsely populated Great Plains stretch to the banks of the Mississippi, a full 650 nautical miles away. For the most part these consist of prairie land, with agricultural land, major settlements and small woods concentrated along the river courses.

The spacious city on the dividing line between barren mountains and almost equally barren plains is reached via broad, four-to-six-lane highways or by train, or better still by aircraft to the city airport of Peterson Field, which lies a good 6,000 ft. above sea level. Here *Interavia's* two reporters were met by an ADC officer, who took them by car to Ent AFB.

At the entrance to the base there was the usual checking of passes by the Air Police; beyond the gate a building, looking rather like a school, for the North American Air Defense Command offices, with the windowless, block-constructed NORAD control center close by. In addition there are a number of huts for other ADC and NORAD offices, the canteen, Base Exchange, barbershop and base hotel. The mixture of Air Force, Army, Navy and Canadian uniforms emphasises the inter-service character of the headquarters.—However, there was little time for idleness, for ADC's Information Officers, Colonel Mayal and Lieutenant Colonel Staff, took charge of the new arrivals and explained to them the most important facts concerning the Command. These can be briefly summarized as follows:

- **THE ADC MISSION:** Protection of the United States and neighbouring areas from air attack, in collaboration with sister units from the U.S. Army and Navy, the RCAF and Canadian Army, and under the command of NORAD.
- **STRENGTH:** more than 100,000 officers, N.C.O.s and enlisted men.

A Martin TM-61C guided bomber of the 17th Tactical Missile Squadron is prepared for launching.

• **OPERATIONAL UNITS:** more than 60 all-weather interceptor squadrons of roughly 25 aircraft each, of the following types:

- single-seat North American F-86D *Sabres*
- two-seat Lockheed F-94C *Starfires*
- two-seat Northrop F-89D *Scorpions*
- single-seat Convair F-102As.

ADC's interceptors are armed entirely with rockets and no longer carry cannon. The number of 2.75-inch unguided rockets carried can be 24, 48 or even 104, and the two last-mentioned aircraft types are also armed with up to 6 Hughes GAR-1 *Falcon* guided missiles. In July 1957 a Douglas MB-1 guided missile with atomic warhead was fired by the leader of a formation of 3 Northrop F-89s, and it may be assumed that certain special ADC units are already armed with the MB-1.

• **NEW INTERCEPTOR TYPES:** the three older North American, Lockheed and Northrop interceptors are being progressively replaced by the following supersonic types:

- single-seat McDonnell F-101A *Voodoos*
- two-seat McDonnell F-101Bs
- single-seat Lockheed F-104A *Starfighters*
- single-seat Convair F-106s
- Boeing IM-99 *Bomarc* missiles.

While the manned interceptors will continue to be armed with guided missiles and unguided 2.75-inch rockets, the unmanned IM-99 *Bomarc* will carry a warhead with proximity fuse.

• **RESERVES:** in the event of war, ADC would immediately be reinforced by personnel and aircraft from other commands, namely the Air Training Command, Continental Air Command (the USAF's Reserve organization) and the Air National Guard (air reserves belonging to the individual States), and even certain fighter units from Tactical Air Command. The some 1,500 all-weather fighters directly controlled by ADC would thus be supplemented by another 2,000 to 3,000 jet fighters.

• **DEPLOYMENT OF FLYING UNITS:** ADC's roughly 60 interceptor squadrons are deployed as follows:

- with **sixteen NORAD Air Divisions** in the west, center and east of the Continental United States. Divisional commanders are also combat commanders and bear responsibility for protecting their own sectors. They come direct under the orders of CINCNORAD (General Patridge) and his staff at Colorado Springs.

Air Defense Command's all-weather interceptors are armed solely with rockets. Picture shows the latest Hughes guided rocket, the GAR-2A *Falcon* with infra-red homing, in front of a Convair F-102A.

NORAD's first SAGE station (Semi Automatic Ground Environment) is in operation.

Guard on duty at the entrance to NORAD's Combat Operations Center in Ent AFB, Colorado Springs.

- in **Alaska,** under the command of Lieutenant General Frank A. Armstrong, the local Commander-in-Chief.

- in the **northeast area** (eastern Canada, and the Greenland bases of Tule AFB and Söndreström AFB). These units come under the command of the 64th NORAD Air Division. Particularly close collaboration is provided here with the Canadian air defense organization, which supplies additional squadrons of Avro CF-100 and (soon) Avro CF-105 all-weather fighters.

• **AIRCRAFT DETECTION SERVICE:** the facilities provided for this purpose by ADC, the U.S. Navy and other organizations are impressive and comprise:[1]

1 – three radar chains in Canada, the most northerly of which (DEW) has meanwhile been extended to the Aleutians and the east coast of Greenland.

2 – innumerable individual radar stations (so-called Point Cover Radars) along the Atlantic and Pacific coasts of the United States. These are supplemented by the USAF's Texas Towers in the Atlantic (one Tower is in operation, two others under construction), by the Air Force's and Navy's early warning aircraft, by the Navy's picket ships and radar blimps, and radar stations in Iceland.

3 – some 400,000 voluntary observers in the civilian U.S. and Canadian Ground Observer Corps, who keep watch day and night at some 20,000 observer posts throughout the Continent and transmit their reports to more than 60 filter centers.

4 – an undisclosed number of electronic memory drums and computers to coordinate the air situation with the flight plans of "friendly" aircraft and with all meteorological information (SAGE system = Semi-Automatic Ground Environment). The USAF's first SAGE center is already in operation.

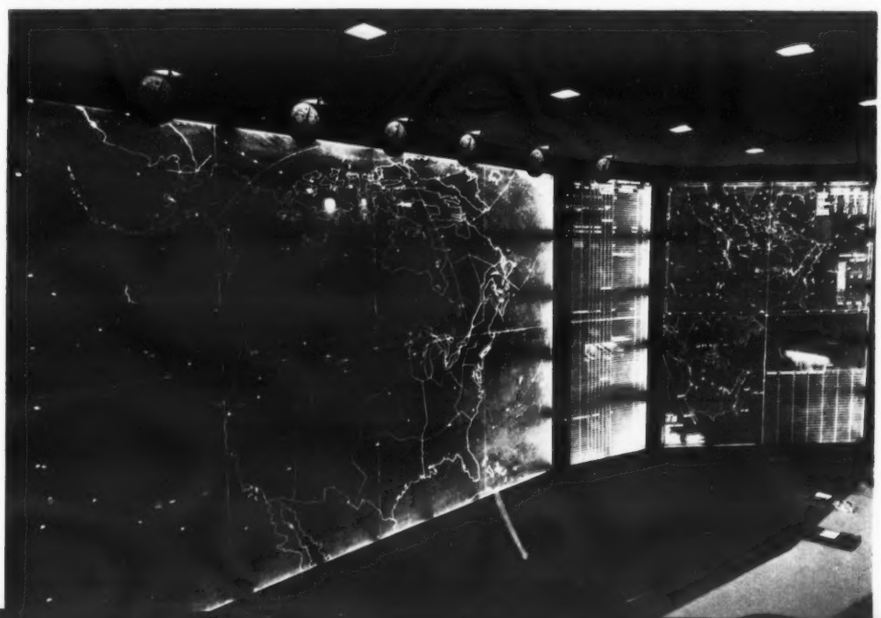
5 – all telephone lines, telegraph and teletype systems, radio communications and forward scatter stations and, in wartime, broadcasting stations and amateur transmitters (code word CONELRAD).

All this was covered by the ADC information officer's comprehensive briefing. One question which comes almost automatically to mind and was put by the two reporters is the following: "How is it economically, or even technically, possible constantly to distinguish between friend and foe and to keep a permanent check on the more than 30,000 flights which take place daily over the North American Continent?"

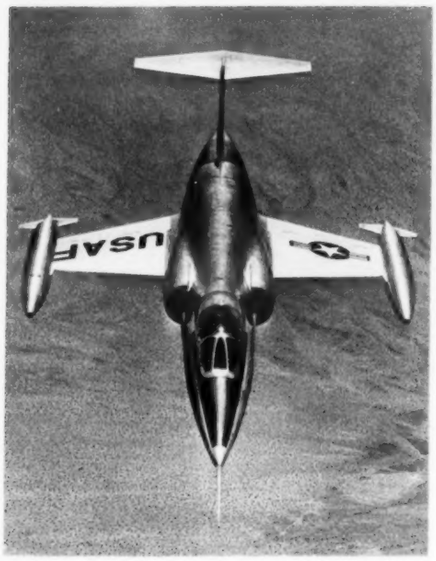
[1] cf. *Interavia* No. 6, 1957, p. 566 etc. and 578 etc., in particular the map on p. 567.

The "auditorium" in the Combat Operations Center.

A plexiglass screen 30 ft. wide, with a map of North America etched on it, is used as surveillance board in NORAD's Combat Operations Center.



USAF



Latest equipment due to come into service with ADC (and NORAD) includes Lockheed 104 *Starfighter* single-seat all-weather supersonic fighters . . .

. . and Boeing IM-99 *Bomarc* interceptor missiles.

The answer was surprisingly simple: "We do not try to. We concentrate on closely checking every aircraft movement within certain critical zones, which are known as ADIZ (Air Defense Identification Zones) or CADIZ (Canadian ADIZ) and are marked on every flying map. These zones stretch over the two coastal strips of the North American continent (Atlantic ADIZ and Pacific ADIZ) and two middle bands, an eastern band running from Florida to near Winnipeg, and a western along the eastern boundary of California.

"Any pilot wishing to fly into an ADIZ must submit a flight plan before take-off and then keep to it strictly. We receive these flight plans via the Civil Aeronautics Administration and compare them in time and location with the blips on our radar screens. If we are not able positively to identify one of these blips, we send up an interceptor to have a close look at the intruder."

The pride of Ent AFB is, of course, NORAD's *Combat Operations Center* (COC), the windowless reinforced concrete structure next to the main building. Admittance is by special pass, which, however, permits ordinary visitors to enter only the control room—laid out rather like a lecture hall—but not the adjacent information center. The COC has already been described in detail in these pages[2], and a brief mention here will suffice.

The COC's task is to be capable of detecting any imminent air attack on United States territory and alerting or warning all military and civilian agencies—in particular air defense units and civil defense—in good time. For this purpose the COC is connected directly with all NORAD units in the United States, Canada, Alaska and Newfoundland by 176 different communications channels (teletype and telephone lines), and, via the Commander-in-Chief's red (hot) line, with the Pentagon, Strategic Air Command and Tactical Air Command. The air situation at any given moment is chalked up, over the etched outlines of North America, on a giant plexiglass plotting board measuring 20 ft. by 30 ft. Plotting is done by WAFs, who work on three levels behind the board and write backwards, so as not to obscure the plots from the watching controllers.

[2] cf. *Interavia*, No. 9, 1955, p. 670 etc.

Visit of the Chiefs of Staff to NORAD's Combat Operations Center. Seated (left to right): General Pate (Marine Corps); General White (USAF); General Twining (Chairman of the Joint Chiefs of Staff); General Taylor (Army); Admiral Burke (Navy). Standing: General Partridge (CINCNORAD); Lieutenant General Atkinson (ADC); Air Marshal C. Roy Slemon (RCAF) and, far left, Colonel Barney Oldfield.

Interview

Colonel Harry W. Shoup

Director of Combat Operations, North American Air Defense Command, Ent AFB, Colorado.

Interavia: We have been greatly impressed by NORAD's vast detection and identification facilities, and the constant readiness and fire power of its all-weather fighters. But, is it really possible to keep such concentrated watch, day and night, month after month, that no surprise attack can remain undetected?

Colonel Shoup: The answer is yes! We have introduced a kind of "fail-safe" system in our detection and identification service to make good for individual deficiencies. We prefer to send up one interceptor too many to identify a doubtful plane, rather than one too few. Even weather forecasts are evaluated in order to foresee possible attack routes. We have to carry out a tough job, one of the toughest there is. But we know it, and there will be no complacency. Remember that when the Japanese attacked us at Pearl Harbor there were three Japanese peace-makers right in Washington. The NORAD duty officer has to stay in this Combat Operations Center all the time. His meals will be brought up to his desk. We know, of course, that our air defense system is not absolutely impenetrable but we can ensure that no surprise raid on our country's vital installations and organizations will be successful. Our plans are made and will be carried out.

The glassed-walled control room for the Commander-in-Chief, General Partridge, and his Deputy, Air Marshal Slemon, is slightly raised and lies behind the "auditorium" for their staff. This room is flanked by similar cabins for the three subordinate commanders, Lieutenant General Atkinson (ADC), Lieutenant General Mickelsen (U.S. Army) and Rear Admiral Rodee (U.S. Navy). In the event of war, the "Battle of America" would be directed from General Partridge's control room.

ADC and NORAD are confident that its manned supersonic interceptors can ward off enemy manned combat aircraft. So far, however, no defense is available against the impersonal threat of unmanned intercontinental ballistic missiles. Nevertheless, it can be said that America's best rocket brains are working feverishly on the development of anti-missile missiles, to supplement the present potentialities of ICBM reprisals. Needless to say, any air or missile attack on the territory of the United States or its NATO Allies would trigger off an immediate counter-blow from SAC's mailed fist.

STRATEGIC AIR COMMAND

What of SAC, the center of the greatest concentration of military strength of all times, a command which controls half a hundred atomic-equipped combat wings at as many bases spread throughout the world? Our reporters understandably felt some excitement when a twin-

engine Air Force communications aircraft finally set them down—after an eight-hour flight—in front of SAC Headquarters at Offutt AFB, near Omaha, Nebraska. The great airfield on the Missouri River, with its two intersecting, 10,000-foot runways, can be spotted from a considerable distance away. This, however, does not at all worry SAC, since the actual control and information center lies deep underground in an atom-bomb-proof shelter, and the hangars at the base are practically empty, except for a few aircraft undergoing overhauls.

Offutt AFB lies roughly in the geographical heart of the giant land mass of North America: 1,130 nautical miles from New York, 1,450 from Miami, 1,450 from Los Angeles. The climate is typically continental—bitterly cold in winter, grilling hot in summer. On this August day the tennis courts were still empty at 7 o'clock in the evening. "No playing if temperature is over 90 degrees" announces an order attached to the gate . . . and in SAC orders are taken seriously, even in private life.

The official briefing was scheduled for early the next morning and was given in the above-ground portion of the newly-erected headquarters building, a long, air-conditioned, three-storey structure. Passes are checked at the entrance by SAC military police, who wear a slightly different uniform from the normal Air Police. Their caps are berets of Royal Air Force style, and their service revolvers—fairly loose in their holsters—have horn handles.

Colonel Reade Tilley, Lieutenant Colonel Donald C. Foster and Major John J. Oswald, of the Office of Information Services, received their visitors and acquainted them with the following facts:

● **SAC'S MISSION:** to safeguard peace by deterring a potential aggressor through the threat of atomic reprisals which could be carried out *at any time* and at any point of the globe; in the event of war to destroy the enemy's air power (phase 1) and the enemy's war potential (phase 2).

● **COMMAND:** The Commander-in-Chief of SAC is *General Thomas S. Power,* who takes his orders direct from the Joint Chiefs of Staff.

● **STRENGTH:** more than 198,000 officers, N.C.O.s and enlisted men, 98% of whom are in the flying units or maintenance squadrons.

● **OPERATIONAL UNITS:** 51 combat wings divided into four Air Forces and three Air Divisions:

Above-ground portion of the newly erected SAC headquarters at Offutt AFB, near Omaha, Nebraska.

2nd Air Force (Hq. Barksdale AFB, Louisiana), 8th Air Force (Hq. Westover AFB, Massachusetts), 15th Air Force (Hq. March AFB, Calif.), 16th Air Force (Hq. Madrid, Spain), 3rd SAC Air Division (Guam), 5th SAC Air Division (North Africa), 7th SAC Air Division (Great Britain). Each SAC Air Division as a rule comprises two combat wings of three squadrons (15 aircraft each), one tanker squadron (20 aircraft), two maintenance squadrons and one A&E (Armament & Electronics) squadron.

● **AIRCRAFT (in service):**

- Boeing B-52 eight-jet bombers (crew of 6)
- Boeing B-47 six-jet bombers (crew of 3)
- Boeing KC-135 four-jet tanker/transports
- Boeing KC-97 four-engine tanker/transports
- Boeing RB-47 six-jet long-range reconnaissance aircraft
- Convair RB-36 six-engine (plus four-jet) long-range reconnaissance aircraft.

● **NEW FLYING EQUIPMENT** (under development):

- Northrop SM-62 *Snark* single-jet intercontinental self-guided bombers (a first SAC operational *Snark* squadron is now being formed)
- Convair B-58 *Hustler* four-jet supersonic bombers.

● **TRAINING:** both crews and aircraft are kept in a permanent state of readiness and training. Crews are divided into four groups, according to their degree of training:

- Select crews,
- Lead crews,
- Combat ready crews,
- Non-combat ready crews.

Grading is done by a special Evaluation Squadron on the basis of the flying and navigational proficiency of each crew, in particular the accuracy of its target approaches and aerial refueling contacts. For example, at least six "wet" hook-ups, including three on radar rendezvous, are required to reach "combat readiness" rating. Flights are made by day and night, often with as many as four in-flight refuelings per flight. During the 1956 calendar year a total of 1,350,000 "tactical" flying hours and more than 150,000 refueling hook-ups (with some 150,000,000 gallons of fuel transferred) were recorded by SAC. On every flight crews must "bomb" simulated targets, when the bomb release button transmits a radio signal, so that the radar unit at the target location can later fully reconstruct the simulated bombing (with allowance for altitude, speed and wind). In addition, the most highly qualified crews study—often for months—the "live" targets which are allocated them for the event of war and are selected in conjunction with the Joint Chiefs of Staff. Each crew must also fly without pressurization at stated intervals, preparing itself for this extremely arduous test by breathing pure oxygen for an hour on the ground beforehand (to remove the nitrogen from the blood circuit). Finally, it must successfully complete a 17-day course at the famous Survival School

The underground portion of SAC headquarters. Designed to be atom-bomb-proof, the fortress contains everything required for the control of global operations, in particular the command room shown here (with operational plans), a communications center and an electronic computer installation.

USAF

Captain Harold J. Hickcox at the controls of his eight-jet Boeing B-52.

SAC's bomber crew No. 1: left to right, Major Polhemus, Captain Grady and Lieutenant Colonel Amos, winners of the 1957 bombing contest.

In the control tower of a Strategic Air Command base.

at Stead.—The average age of SAC aircraft commanders is today 35, and each has some 12 years commissioned service and 4,200 flying hours behind him.

● **GLOBAL MOBILITY:** That SAC bombers are capable of reaching any point on the globe from their home bases was strikingly demonstrated by "Operation Power Flight" in January 1957, during which three SAC Boeing B-52 bombers flew round the northern hemisphere non-stop (21,100 nautical miles in 45⅓ hours), with four air-to-air refuelings. In August 1957 a Boeing B-47 flown by Brigadier General James V. Edmundsen provided a further proof by covering the 10,000 nautical miles between the Pacific island of Guam and an SAC base in Morocco non-stop in 22 hours and 50 minutes. But SAC has also catered for global mobility of entire wings, providing for every operational bomber a "fly-away-kit" which is carried in the bomb bay and contains essential spares to support the wing for 30 days. SAC's tanker/transports are also equipped so that the whole fuel supply is carried on the lower deck, and the upper deck remains empty. Most tankers can thus at any time be used for urgent transport jobs.

● **COMMUNICATIONS NETWORK:** SAC possesses its own vast communications network, consisting of landlines, radio stations and scatter stations. The "simplified diagram" of this SACCOMNET looks not unlike a diagram of coal derivatives and reveals only the main centers (Offutt, Westover, Barksdale, March) with any degree of clarity. Most messages are transmitted and received by teletype, in automatically coded form. However, SAC has also obtained good results with the facsimile transmission of maps and written documents in clear, and even of airborne radar display.

The visitors were then shown an unclassified example of one of the many plans for operations SAC might be called upon to undertake in the event of war with the Soviet Union. *The plan assumed that the closest strategic targets in Russia would be destroyed within thirty minutes of the first SAC aircraft being picked up by Soviet radar stations, and that the whole of European Russia would receive a knock-out blow within a further ninety minutes.*

Their first question was an obvious one: "But—even using atomic bombs—it is surely not possible to wipe out all strategic targets in this huge territory with a single blow? After all, the Soviet Union's most important industrial plants lie far beyond the Urals." In SAC the opinion seems to be: "During the first few hours of a global war—which we hope both we and the Russians will be spared—it is not likely that SAC would attack the enemy's industrial centers, rather it would probably concentrate on air power and other military targets, such as the major air bases, air power support, stockpiles, and command and control centers. SAC would choose weapons according to the target, which could be an airfield or a five-thousand acre depot or a number of advancing armored divisions. SAC aircraft might also be used in a local war. Anywhere in the world the bombers are needed, they can be there in hours in the required numbers . . . one aircraft, twenty or a thousand."

What of the degree of accuracy obtainable in homing on targets? The answer was: "Our crews are so experienced that after a flight of 600 nautical miles using only dead reckoning they will be within a maximum of 15 nautical miles of the target. With astronomic navigation the maximum navigation error is 13 nautical miles, no matter where or after how long a flight. But if celestial navigation is combined with radar the navigation error is practically zero."—*Is Doppler radar used for navigation and target homing?* "Sorry, no comment!"

Conversation becomes very lively as soon as the personnel problem, one of SAC's biggest headaches, is touched upon. SAC is a professional force, and each member, whether he be pilot, navigator or ground specialist, requires a very long and costly training. Officers, i.e., all pilots and navigators, sign on for five years' service, while the enlisted men and N.C.O.s of the ground staff (airmen) undertake to serve only four years. However, whereas on an average only one in four of the pilots and navigators leave SAC after their five years' engagement, four out of every five airmen fail to re-enlist . . . primarily because the specialized knowledge they have acquired qualifies them for better-paid jobs in industry. But it takes practically the whole period of service to train a mechanic for the K navigation equipment (and bomb sight), for example, to the grade of supervisor or inspector, and much the same applies to the specialists in radio and radar equipment. To remedy the situation, SAC has worked out a number of proposals—such as better pay, vocational education and better promotion prospects for airmen, a housing and recreation program for dependents, etc.—and hopes to get them approved by Congress. Everything the Command can itself do to offer its men a better status and greater comfort is being done. For example, the messes and club rooms at SAC bases are as a rule exceptionally well equipped.

*

After the briefing, the visitors were taken to the below-ground half of SAC Headquarters, the SAC Command Post. At the end of the entrance tunnel are thick armour-plated doors with automatic locks, and the whole of the three-storey underground building would be hermetically sealed and pressurized in the event of an air attack warning. The doors are also guarded by a politely distrustful SAC Police sentry, who not only minutely examines every pass but also checks by telephone that the bearer may indeed enter.

The Command Post contains everything that is needed for the detailed control of global operations:

- the Commander-in-Chief's control room
- the communications center
- a global weather center
- the Air Intelligence Room
- the Operations Planning Room
- an electronic computer center
- an air conditioning system, an independent water supply, an emergency electrical power system, and emergency rations for 30 days.

The Commander-in-Chief's impressive control room on the lowest floor of the atomic fortress has daylight lighting, and is 140 ft. long, 39 ft. wide and 21 ft. high. Along one side are the glass-walled offices for General Thomas S. Power and his immediate staff, while the opposite wall is covered from floor to ceiling with map panels. The latter, totalling 100, run on a multi-track rail system and can be moved, exchanged or covered by other panels at will. The rearmost layer of panels is normally kept covered, since they contain a state secret of the highest importance, SAC's *emergency war plan,* under which America's intercontinental bombers would operate in the event of a surprise attack on the United States . . . at any time, within a few minutes of the order being given by the President of the United States or the Joint Chiefs of Staff.

Operational details of the emergency war plan are constantly brought up to date and contain not only the coordinates of the first priority

A SAC Boeing B-47 taxying along the runway with, exceptionally, both its large brake parachute and its small landing parachute in operation simultaneously.

strategic targets in the enemy's territory, but also the locations of his radar stations, rocket batteries and fighter units, and finally the optimum attack routes, as worked out by the operations section, through the weakest points in the enemy defense system and with due regard to prevailing weather conditions.

In preparing operational orders, the emergency war plan or any other plans considered necessary in a given situation, the operations section uses a giant IBM 704 electronic computer and its unfailing magnetic drum "memory". Thanks to this machine it is even possible to check through a long list of conceivable counteractions to every SAC operation, as in a war game. In wartime, the computer could also be called upon to work out modifications to operations already in progress—in the light of new information on the enemy's dispositions, for example—or to assess the effects of bomb damage to the enemy.

In the communications center some hundred punch tape teleprinters with automatic enciphering equipment clatter day and night. Direct telephone lines run to every SAC base on American territory, and R/T channels to the four overseas SAC headquarters. Via these communication channels the Command can talk to any crew in flight. All telephone conversations are recorded on magnetic tape. For the transmission of reports and orders inside the fortress there is also an extensive internal telephone system and a closed circuit television network.

Lincoln AFB's nine-storey control tower.

*

Finally, our reporters were granted the privilege of visiting a SAC operational base. This was Lincoln AFB, some 50 miles from Omaha, headquarters of the 818th SAC Air Division and hence of the 98th and 307th Bomb Wings. On the airfield were some forty Boeing KC-97 tanker/transports (two refueling squadrons) and roughly sixty Boeing B-47 jet bombers. The Air Division's other thirty bombers were thus absent on training flights. One B-47 was just approaching to land, and on its down-wind leg, trailing a mighty brake parachute behind it, which it jettisoned before turning into the base leg. A few moments later, however, a new brake parachute was unfolded.

"We use two brake parachutes in our B-47s", explained *Colonel Wilson R. Wood,* Commander of the 98th SAC Bomb Wing, "one large drag chute for the approach maneuver, and a smaller landing chute for the actual landing. Naturally, this quick-change program—like everything else we do—has to be practised."

The Colonel then introduced his visitors to one of the bomber crews, who were preparing for a training flight. Three Herculean men, all over six foot tall, came forward in normal overalls, with their flying helmets and oxygen masks under their arms, and bowie knives—for any eventuality—on their right hips: Captain H. K. Wheeler (45), aircraft commander, First Lieutenant K. B. Thomas (25) co-pilot, Captain T. A. Crorey (39) navigator-bombardier.

"Inspection" began with each man's personal equipment: parachute with barometric release capsule and emergency oxygen supply for three minutes; lifejacket; thick brief case with maps and target studies; canvas bag containing navigation equipment; powerful electric torch; and finally the famous survival kit (to be attached to the ejection seat). This kit, with its emergency rations, fishing and cooking tackle, matches, medicaments, etc., enables a man to survive "indefinitely" in the wilds—when used in conjunction with the owner's woodsman's qualities.

The visitors were then permitted to climb into the cockpit of a B-47. A strange experience, to be confronted suddenly with six "gas levers" when in one's own flying days, one had had only one, or perhaps two, to cope with. The six sets of engine instruments are also impressive, though the B-47's flight and navigation instruments differ but slightly from the familiar variety.

"Every training flight—average duration seven hours, though with in-flight refuelings they may last up to eight or even nine hours—is preceded by a total of six hours of routine checks on the ground," Captain Wheeler explains. "We work through, point for point, our thick check list, the so-called Bible. Anything that is not in 100% order, whether it is an engine, a radar equipment or even merely the tire pressure in the left outrigger wheel, is immediately repaired by the ground crews.

"But when we take off on our training flight this evening at 23:01 GMT, or 17:01 local time, you can set your watch by us, because it will be neither half a minute before that time nor half a minute after. And we are certain that we shall carry out our mission today, as we always do."

*

SAC today has some 3,000 crews of this caliber and the same number of serviceable bombers. The Command represents an investment of nearly $18,000,000,000 for the American taxpayer, but the political and military leaders unanimously agree that SAC will have scored its greatest success if it never has to go into action.

A Boeing KC-135 tanker transport refueling a Boeing B-52 bomber.

USAF

On NATO's Southern Flank

By Charles Corddry, Washington

For years now, the United States Navy has been regarded as the embodiment of American power and influence in the Mediterranean-Middle East area.

The 6th Fleet, plying between the Straits of Gibraltar and the Levant, shows the flag, stages maneuvers, calls at friendly ports and seeks to have a stabilizing effect on the region. Conducting its operations with 60 ships including two carriers, 135 aircraft and about 25,000 men, the fleet is a focus of continuous world attention.

More recent, and not as well known as yet, is the United States Air Force's expansion in the Mediterranean-Middle East and its emergence as a companion instrument of national power and policy in that strategic, oft-troubled area.

Examples of its swift response to policy decisions were the immediate air delivery of arms to Jordan during the Syrian situation last September, evacuation of civilians in concert with the Navy in the 1956 Suez crisis and rapid movement of United Nations troops in the same crisis.

Those were all responses without firepower. The capacity for swift response with firepower is just as present, in the fighter-bomber squadrons that rotate to Italy from the United States and in the Strategic Air Command bomber units that maneuver from Moroccan, Turkish and Spanish bases.

In a recent tour through six countries bordering the Mediterranean, one could see at first hand the extensive and solid system of air bases, supply centers and communications on which the Air Force could build up rapidly whatever forces were needed. The system is laced tightly together by air transport routes, having a monthly capacity today of 2,500,000 ton-miles in the North Africa-Middle East area, and it is defended by modest numbers of all-weather jet interceptor squadrons.

In Morocco, Libya, Saudi Arabia, Turkey and Greece, the Air Force operates under various agreements at 11 major air bases and numerous smaller ones. It has 12,000 persons stationed at these points. Its investment in facilities, equipment and supplies is more than 550 million dollars.

With the exception of the new Spanish bases, which are administered directly by the Strategic Air Command through its 16th Air Force, the organization in the Mediterranean, Middle East and North Africa is the responsibility of the United States Air Forces in Europe (USAFE). That top command administers the *Dhahran* air base through its 2nd Air Division while all the rest of the vast territory is administered by USAFE's 17th Air Force.

The 17th bolsters the North Atlantic Treaty Organization's southern flank, keeps major bases ready to handle the U.S. Air Force's largest aircraft in event of general war, mounts interceptor defenses, conducts training with missiles and other weapons for units based in Europe, and provides facilities for the smooth-running Air Logistics System of USAFE.

Some of the pertinent details about major bases on which the U.S. Air Force operates in the Mediterranean-Middle East region follow.

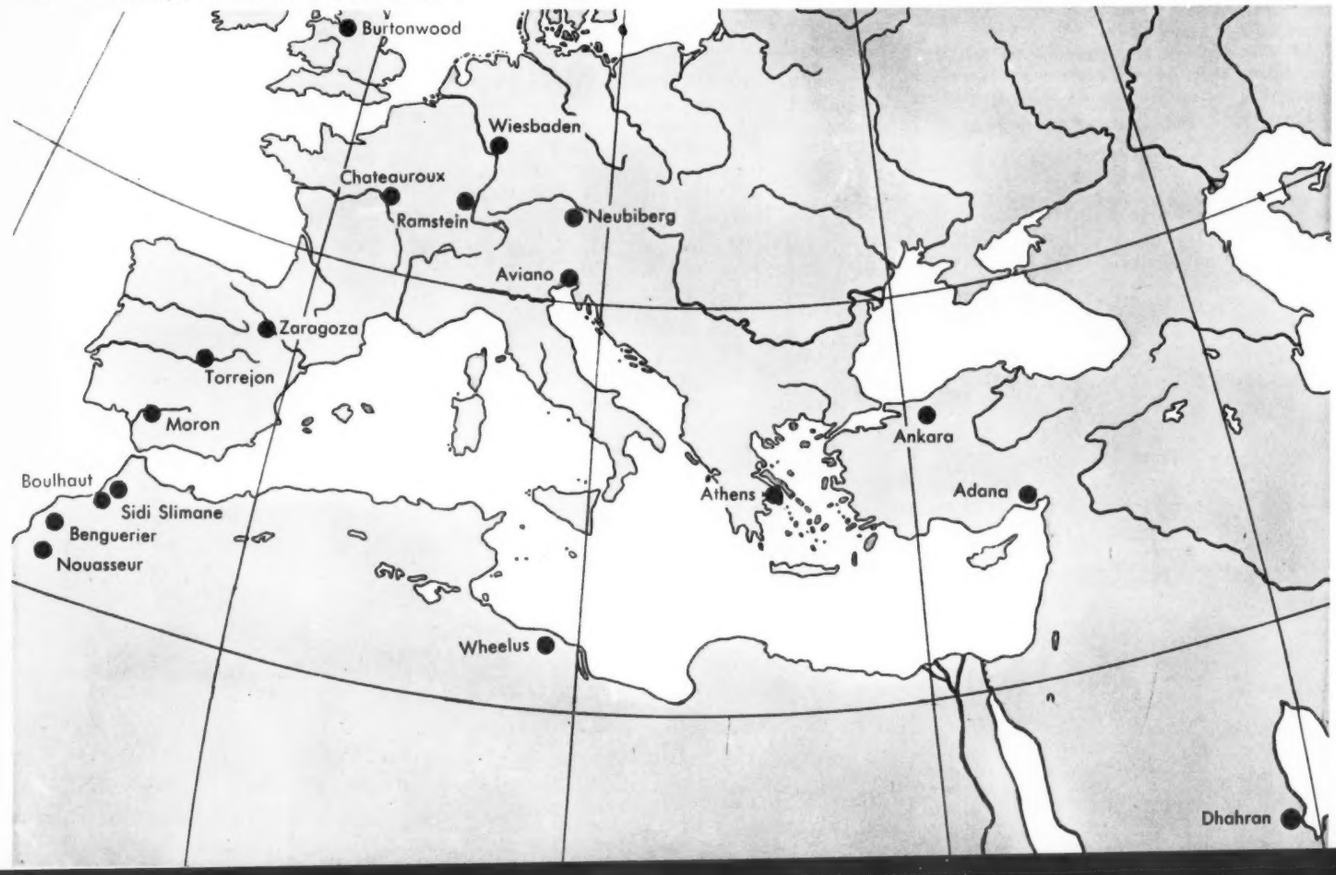
Libya

Wheelus Air Base, seven miles from the city of Tripoli and site of a favorite automobile race track of Mussolini, is headquarters of the 17th Air Force which is commanded by Major General Richard J. O'Keefe. The 17th encompasses territory exceeding the size of the United States. Wheelus is the focal point for air activities that reach out to Turkey, Greece, Saudi Arabia, Iran and Italy. It is a stopover for aircraft bound to Far East countries. Its terminal handled more than 52,000 passengers in 1956. As many as 11,500 landings and take-offs in one month are not unusual.

The Base Commander, Colonel Jack W. Saunders, counts it his most important job to keep Wheelus "in readiness to support a strategic air offensive should it ever be required."

The most important day-in and day-out mission is operation of the USAFE Weapons

USAF Bases in Europe, North Africa and the Middle East.



Center. Each missile and aircraft crew stationed in Europe spends about one month a year at Wheelus undergoing training in bombing, rocketry, air-to-air firing and missile launching. The base has two over-water and one land range as well as a missile impact area. Each of the 36 *Matador* launching crews in the 701st Tactical Missile Wing in Germany must launch one missile a year at Wheelus. Every precaution is taken to clear the desert range in advance of a missile launching and chase planes accompany the *Matadors*. It has never been necessary to shoot down a missile because of a malfunction. Pilots of fighter-bombers rehearse a variety of methods of delivering atomic weapons—high altitude, high angle bombing; high altitude, low angle bombing; low altitude toss bombing, and low altitude, high angle bombing.

Wheelus is home to the 431st Interceptor Squadron, equipped with F-86D all-weather aircraft for the defense of the Libyan area.

The giant air base is in many respects a transplanted American community, supporting 12,000 persons—servicemen and their families.

Spain

The Strategic Air Command has begun to operate bombers from the complex of mammoth bases in Spain, its first on the European continent although it has operated from bases on the fringes of the continent for years, in England, Africa and Asia Minor. When ready for full use by next summer, the bases will be "among the most complete and well equipped U.S.A.F. installations in the world," the Air Force says. Total eventual cost of the SAC bases and the big U.S. Naval base at Rota is estimated to be 350 million dollars of which about half has now been paid out.

There are three main bomber bases, all with fighter defenses. The *Torrejon base*, 15 miles northeast of Madrid, is headquarters of the 16th Air Force. Its 200-foot wide runway is 13,400 feet long with a parallel taxiway of the same lenght. It has a parking apron 1½ miles long and ¼ mile wide. There are 30 fueling hydrants, each with 100,000 gallon storage and 600 gallons per minute flow. There will be barracks and officers' quarters for 4,471 persons but in peacetime the normal complement probably will be 2,000. Modern operations, storage, maintenance, utilities and recreational facilities are provided.

Zaragoza base, in northeastern Spain, has a 12,000-foot runway. Its facilities are comparable to Torrejon's. It will accomodate 915 persons but its peacetime complement probably will be 500. *Moron*, 37 miles southeast of Seville, is the third bomber base. Its runway is 11,800 feet long and facilities compare with the other bases'. It will house 649 persons but, like Zaragoza, probably will have 500 in peacetime.

It is contemplated that only Torrejon will have full peacetime use by SAC bomber wings, rotating from the United States for 60 to 90 day periods. The other two bases will be kept in constant readiness in case of need.

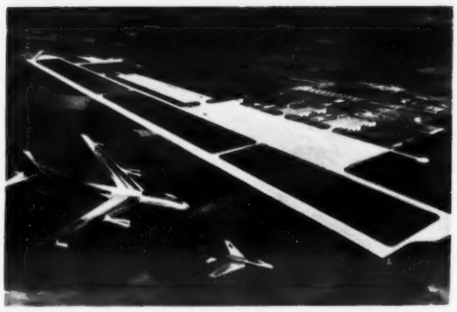
The bases are supplied fuel by means of a pipeline running from Rota on the southwest coast. It was found that a wing of 45 B-47 *Stratojet* bombers consumes more fuel in an afternoon than the entire Spanish railroad tanker fleet could transport in a month.

USAFE's tactical units use the "buddy" in-flight refueling system to increase their range. Picture shows an F-84F *Thunderstreak* fighter-bomber refueling an RF-84F *Thunderflash* armed reconnaissance aircraft.

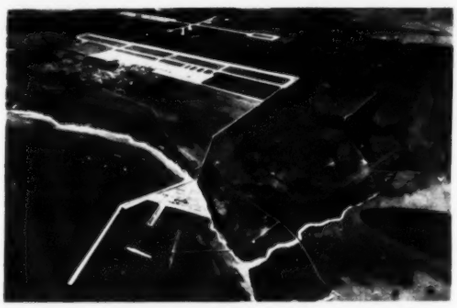
Each of the launching crews of USAFE's 701st Tactical Missile Wing (equipped with TM-61 *Matadors*) must launch one missile a year at Wheelus AFB, near Tripoli, Libya.

TM-61 *Matador* tactical missiles at the ready on their mobile ramps, at Bitburg, Germany.

USAF



Torrejon base, Spain (left) houses the headquarters of SAC's 16th Air Force, while Moron (right) will be kept in constant readiness in case of need.



SAC has a second alternative base in northeast Spain, near Zaragoza (left). The U.S. Naval base at Rota on Spain's southwest coast (right) is being equipped as terminal of the pipeline to supply Torrejon, Moron and Zaragoza with fuel.

An F-100 *Super Sabre* practises low-level attacks at Wheelus AFB's firing range.

Portuguese peasants appear quite undistubed by the sight of an imposing row of B-36 intercontinental bombers which have landed in the Azores on a training mission.

OTHER AREAS:

Morocco

Here are four great bases, *Nouasseur, Benguerir, Boulhaut* and *Sidi Slimane,* which can handle jet bombers of any size and are used by the Strategic Air Command. SAC has its 5th Air Division headquarters at Sidi Slimane. Nouasseur has the air depot for USAFE's Southern Air Materiel Area, supplying operations in North Africa, the Middle East and Greece. Fighter units from the continent undergo transition and gunnery training at Moroccan bases.

Saudi Arabia

Dhahran air base, headquarters of the 2nd Air Division, provides logistical support for U.S. government agencies in the Middle East and training assistance to the Saudi Arabian government. It can handle the Air Force's largest aircraft.

Turkey

There are probably 800 American airmen in Turkey, spread through support squadrons and detachments of the United States Logistics Group at 10 different locations. Some are at the big *Adana base,* 400 miles southeast of Istanbul, which is commonly supposed to be a standby base for Strategic Air Command use. American airmen head the 6th Allied Tactical Air Force, the NATO command in which Turkish and Greek units would serve in wartime.

Greece

Athens is the hub of USAFE's Air Logistics Service and Air Force communications serving the eastern end of the Mediterranean. A detachment of C-119 and C-54 aircraft is based here for operations to Wheelus and the Middle East.

Italy

An American atomic strike force of approximately 25 fighter-bombers is stationed at all times in northern Italy. The unit is based at *Aviano,* a NATO base, operated by the 17th Air Force and located at the foothills of the Carnic Alps 80 miles northwest of Trieste. The fighter-bomber squadrons rotate from the Tactical Air Command in the United States for six months tours in Italy. Their aircraft currently are F-84F *Thunderstreaks,* which have a range of 1,500 miles without in-flight refueling. When units arrive at Aviano, they are accompanied by C-124 aircraft bearing 30-day supply kits. The supply line from home base is never more than nine to seventeen days long.

*

With the expansion of U.S. Air Force Mediterranean operations, there has been a steady build-up of local air forces on NATO's southern flank. More than 1,000 jets of American design—*Thunderjets, Thunderstreaks* and *Sabres*—now fly in the ready combat units of Turkey, Greece and Italy.

The one-time soft underbelly of Europe appears to be developing some hard muscle.

DE HAVILLAND ENGINE RESEARCH SPEEDS THE WAY AHEAD

A series of paintings by W. Howard Jarvis, S.Av.A., illustrating aerodynamic shock-waves

M = 2·6

No. 5

Manoeuvrability at extreme speed and altitude is graphically illustrated in this painting of a hypothetical aircraft as it reverses direction in the stratosphere. In addition to the typical shock-waves from the air frame, the diamond-type shock pattern is clearly seen in the high-velocity rocket efflux.

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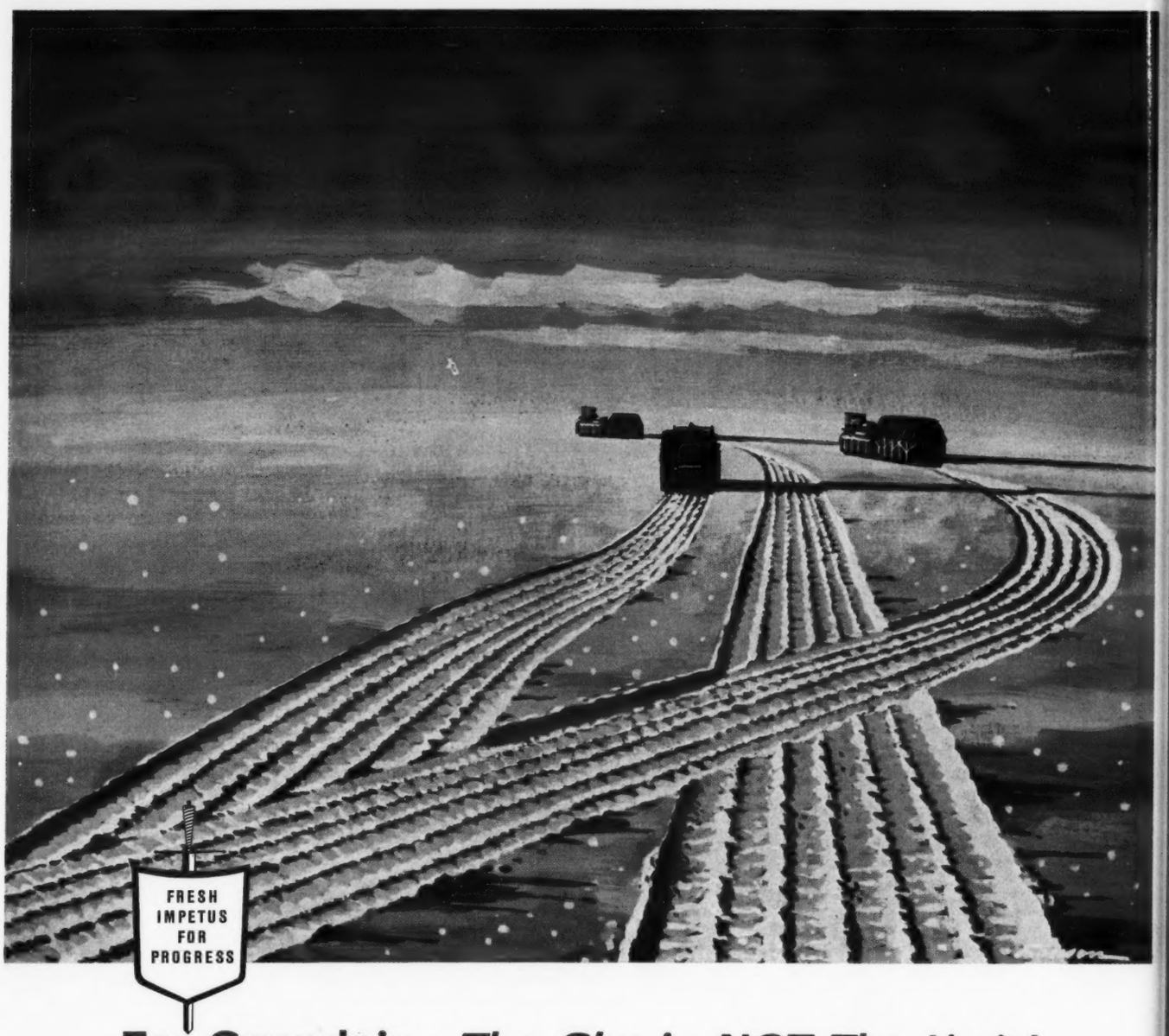

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The USAF Still Holds the Trumps

BY BRIGADIER GENERAL PIERRE M. GALLOIS, PARIS

Has the "big stick" changed hands? The basic American defense policy of deterring a potential aggressor through the threat of nuclear reprisals uses as its main instrument the USAF. But recent Soviet tests of intercontinental missiles and the launching of the first artificial satellite have created in the public mind the impression that the Strategic Air Command, which is still equipped with manned aircraft, is shortly to be confronted by Russian long-range ballistic missiles in quantity. This leads to the further belief that the Western Powers' "rampart", the Pretorian Guard which guarantees their "survival", will be outflanked by more efficient, absolute weapons against which there is no defense.

The reality is vastly more complex. Even if the intercontinental ballistic missile could emerge by some process of spontaneous evolution and if engineering in the East had far outpaced the West, the military advantage would still not be overwhelming, since any attempt at blackmail through the threat of attack by nuclear-warhead ballistic missiles would still be accompanied by excessive risks. To be truly effective, this leap forward—at the moment unilateral—would have to be allied with even greater progress in the defensive field. Besides being able to launch "offensive rockets", an aggressor would have to be certain that he could intercept the consequent reprisal forces with defensive missiles. And the deficiencies of present defensive systems, even against long-range subsonic aircraft, are well known.

In January 1954 John Foster Dulles made a public statement which clearly summarizes what has been America's defense policy up to recent years: "Local defenses will always be important, but there is no local defense which, alone, will contain the mighty land power of the communist world. Local defenses must be reinforced by the further deterrent of massive retaliatory power."

The "commonplace" explosive

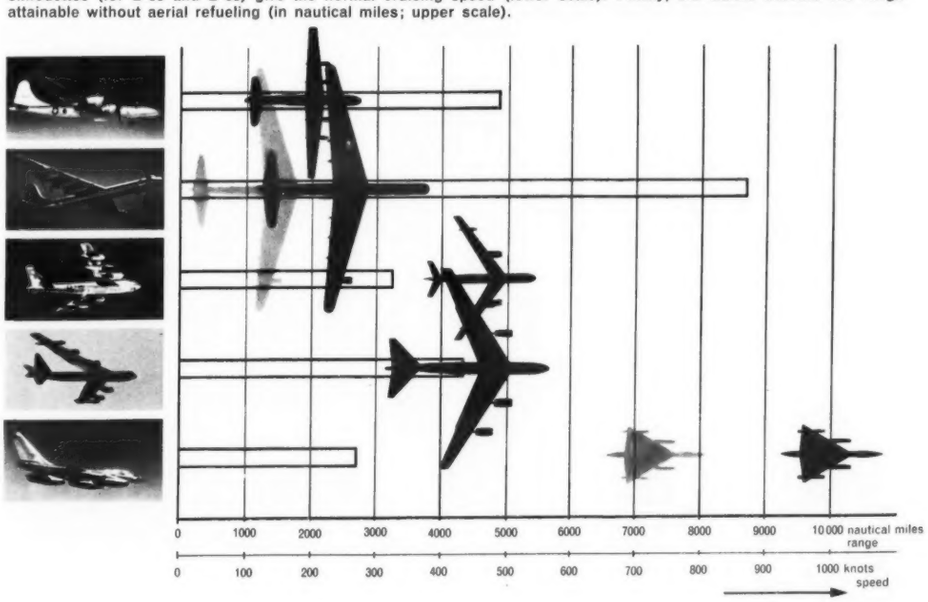
The nuclear explosive, its "carrier vehicles" and the bases from which the latter operate are the three elements of the composite aeronuclear picture. Each has had repercussions on the conditions of employment of the others. Originally heavy and bulky, the atomic explosive could be carried only by heavy, relatively slow bombers, built up around the large bomb bay and the high-capacity fuel tanks required to give them the necessary range. Five or six years after Hiroshima, the USAF announced that its fighter-bombers were now capable of transporting an atomic bomb. Suddenly—provided the range required was short—the "bomber" equalled the fighter in speed. The handicaps of a large bomb bay were eliminated, and the A-bomb carrier no longer differed very greatly from the aircraft whose task it had been to intercept it. The strategy of "proximity", utilizing a system of bases located near the territory held by a potential enemy, imparted a new advantage to the offensive over the defensive. Conversely, however, these bases became increasingly vulnerable as the potential adversary succeeded, in turn, in miniaturizing his projectiles.

Two years later, the power of destruction stored in a single projectile had been increased a thousandfold, and the area affected by the explosion had become thirty times as vast. Hence the number of carriers required to neutralize a given area could be substantially reduced, bombing accuracy could be smaller, and, above all, new methods of launching had to be evolved. The latter again had repercussions on the design and equipment of the carrier vehicles. More recently still the hydrogen projectile has also been reduced in size and weight. As, at the same time, stocks of fissile material were growing, it was possible to construct nuclear projectiles to suit a variety of carriers, and even to include atomic warheads in missiles, to supplement manned aircraft. It thus took a bare twelve years to advance from the B-29 "Enola Gay", which dropped a bomb equivalent to 20 kilotons of TNT on Hiroshima, to the atomic air-to-air missile which was launched by a fighter over Yucca Flat, Nevada, in July 1957.

From Mach 0.5 to Mach 2.5

In the immediate post-war period the limited range of the B-29 and B-50 necessitated a strategy of proximity, involving the well-known handicaps from the political, military and financial points of view. The Convair B-36 then gave the USAF the extra range it needed. First calculations for this aircraft are said to have been made in 1943—1944, when the American amphibious forces found themselves obliged to conquer one island after another in the chain across the Pacific before, on reaching Okinawa, they could get their B-29 squadrons within striking distance of Japan. The B-36 was the answer to American prayers. It gave them an instrument capable of operating from U.S. territory. It had the combined advantages of eliminating the need for external supply lines, thus

Speed and range of Strategic Air Command's manned bombers, from the B-29 to the B-58. The tips of the black silhouettes show the max. level speed obtainable with emergency power (in knots; lower scale), and the two grey silhouettes (for B-36 and B-58) give the normal cruising speed (lower scale). Finally, the bands indicate the range attainable without aerial refueling (in nautical miles; upper scale).



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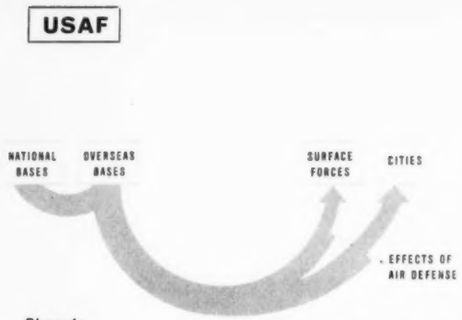
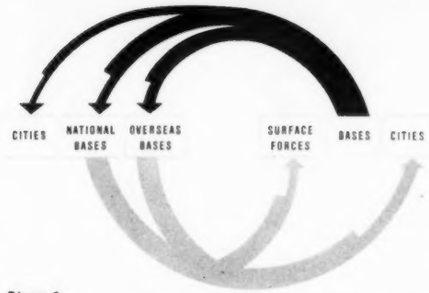
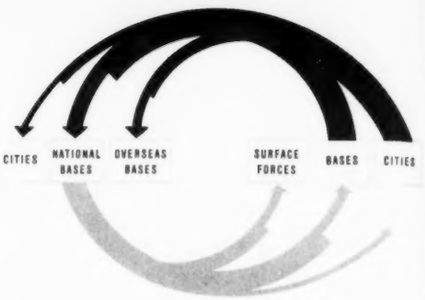


Phase 1:
One side holds the monopoly of nuclear explosives and carriers
This phase corresponds to the atomic monopoly which the United States held in practice until 1951 or 1952, despite the fact that the first Soviet atomic explosion took place in 1949. If America had had aggressive designs, she would have been technically, if not morally or politically, capable of realizing them, since her aero-nuclear armament could have neutralized the Soviet's greatly superior conventional forces. No air defense system could have intercepted a large enough percentage of the offensive aircraft, even if the latter had been relatively slow B-50s or B-36s.



Phase 2:
Both sides have atomic weapons but unequal carrier resources (no-return missions from East to West)
From 1951/52 onwards any threat to the United States would have been constituted by the combination of the atomic explosive and aircraft of relatively low speed and, above all, of inadequate range to attack distant targets except on a no-return mission. Because of the limitations of the atomic explosive (compared with the fusion bomb), the aggressor would have had to mobilize a substantial armada, he would have lost the effect of surprise, and the whole "affair" would have misfired. Reprisals would have been aimed at the surface forces and probably a few cities.



Phase 3:
Equality in nuclear explosive and "carrier vehicles"
Here each side possesses sufficient projectiles and aircraft to destroy the other's system of bases. This is the era of "clean" atomic warfare; air bases would be the first priority targets, with cities as secondary targets to hasten surrender when all reprisals forces have been lost. It is likely, however, that the more limited knowledge which the United States possesses about the Soviet Union—compared with what the Russians know about the United States—would reduce the effectiveness of any reprisal action restricted to the Soviet bases. Hence the threat of reprisals directed against cities.

freeing the atomic "punch" from overseas territorial and naval support, and yet being able to launch its bombs on the very sources of the adversary's military power. However, although it was a complete success as regards range, it had its weaknesses as regards speed. The usual technical compromise between range and speed had been slanted in favour of range, and the B-36 was found to be vulnerable in the target area. To improve this situation four jet engines were added. With its total of ten engines, the B-36 could then exceed 400 knots at critical moments. But progress in defense was such that greater continuous speed was required. This need was met by the six-jet Boeing B-47. When it first came into service it was almost as fast as most of the interceptors then in operation. In this case, however, speed had been obtained at the expense of range, and plans had to be made to operate it from a ring of bases located as close as possible to its potential targets. At the same time in-flight refueling techniques were developed, to improve flexibility of operation. Next the B-52 brought a new step forward, since Boeing's engineers had succeeded in adding speed to range. But even while the B-52s were coming into service, Convair was testing its B-58 *Hustler*, which is destined to play the same part in relation to the B-52 as the B-47 in relation to the B-36. Finally, in a few years' time, pilotless aircraft and ballistic missiles will be coming along to take over in turn.

Bases and launching sites

The capabilities of America's offensive air equipment have determined the structure of this ring of bases, the peripheral springboard needed to ensure the efficiency of Strategic Air Command. Politically speaking, the problem has not been an easy one. When the Secretary of State was asked what would be the United States' attitude in the event of an attack on Federal territory or on of the Atlantic Powers, he replied that if the United States itself were attacked, retaliation would be immediate and would be carried out from bases situated in American territory; the use of American bases in Allied territory, he added, as for example in Britain or Morocco, depended on agreement with the governments concerned.

The actual installation of air base facilities in foreign countries, even when the latter are official allies of the United States, entails extensive negotiations and meets with a wide variety of difficulties. Examples are the lengthy discussions with the governments of the Philippines, Saudi Arabia (relating to Dhahran), Spain and Morocco, and the recent incidents in Japan and Formosa and even the friction arising over the stationing of American forces in those countries which have been loudest in demanding their presence, such as the countries of Western Europe.

The USAF must be a comprehensive weapon. Its major task is to discourage the outbreak of a major conflict through the threat of aero-nuclear reprisals, but at the same time it must be capable of preventing minor wars or nevertheless of winning them if they should break out. For both tasks free command of a vast network of bases is equally indispensable.

In order to discourage major aggression, i.e., an act of hostility aimed at the existence of the United States as a sovereign power, the following four conditions must be met:

– Possession of the nuclear explosive both in quantity, to saturate the enemy's "capacity of absorption", and in quality, to facilitate the task of the reprisal vehicles.

– Use of carriers capable of penetrating the aggressor's defenses and causing a greater amount of destruction than he can absorb and yet continue the struggle.

– Constant protection of the nuclear explosive and its carriers in all circumstances (surprise attack, sabotage, etc.).

– The widely proclaimed determination to resort to aero-nuclear reprisals at the first act of war.

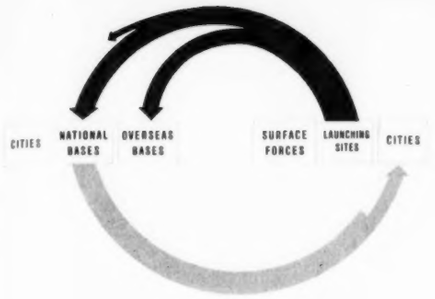
The third of these conditions, namely constant protection of the reprisal instrument, means that bases must be as numerous as possible and widely dispersed in depth. The more bases there are the greater the aero-nuclear forces an aggressor must mobilize. It would thus be difficult for him to retain the effect of surprise, without which he could not hope to destroy his victim's reprisal forces. The greater the offensive resources needed for a given operation, the more difficult it is to preserve the element of surprise.

Preventing simultaneous destruction of bases

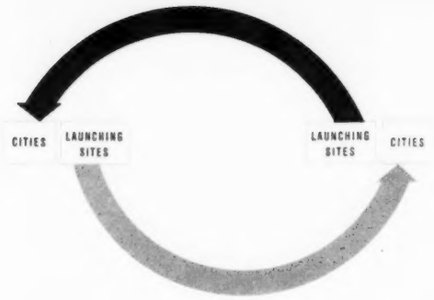
Another important part is played by the geographical situation of the USAF's aero-nuclear bases. Because some of these bases are located within a few hundred miles of the Iron Curtain, while others are thousands of miles away, it would be impossible to launch a surprise attack on them all simultaneously. An attack on the nearest of these bases would give warning to evacuate the more distant ones and, conversely, raids directed against the more distant airfields would alert the closer ones. A detailed study of the problem reveals the advantages of this new aspect of defense. Dispersion, over varying distances, and mobility within this vast checkerboard of bases is found to be a great deal more rewarding than recourse to conventional air defense. Firstly, no defensive coalition can permanently keep a conventional system up to the required pitch of alertness and efficiency, and secondly, the losses that this system can inflict on a raider during the first attack would be too small to be effective in view of the vast damage that can be caused by even a few thermo-nuclear projectiles. This leads to an entirely new situation, where an aggressor can be deterred by the "survival" of the reprisal potential, and this survival does not depend on the conventional means of "active" defense—which becomes progressively less efficient the closer they are to the enemy's sources of power—but on "passive" measures such as dispersion and mobility. Defense becomes indirect and is provided by geographical distance, dispersion and the organization of bases at widely differing distances from the source of attack.

For example, if Belgium were isolated in a violently egocentric world, her metropolitan territory would be indefensible in the military sense of the word. But if she had reprisals forces deployed in the Congo, for example, and if any threat directed at the home country were automatically to set the reprisal machinery in motion, this form of defense would be effective, and the would-be aggressor would be deterred from resorting to force.

A study of the military problems of the aero-nuclear age reveals the fact that if highly destructive offensive weapons are to be used—or, in other words, if this kind of war is not rendered impossible—this can only be done if one side's



Phase 4:
Equality in nuclear explosives, but unilateral lead in intercontinental missiles
It is assumed here that the USSR has achieved a considerable lead in building up stocks of very long-range missiles with nuclear warheads, sufficiently accurate to be capable of being used economically against such relatively small targets as air bases. What remained of the American reprisal forces would probably be used against the aggressor's cities, since his launching sites would be difficult to locate.



Phase 5:
Equality in explosive and long-range missiles
If both sides are equal in both nuclear explosive and intercontinental ballistic missiles to carry it, there might conceivably be no alternative to the mutual threat of destruction of each of the two blocs' principal cities. There could be no "clean" war, destruction of launching ramps, or interception of ballistic missiles. War becomes impossible, because it would lead to virtual suicide.

reprisal forces can be destroyed by the other side. In the age of the aircraft as A-bomb carrier, the result is a war of bases, with a brief exchange of projectiles directed against the enemy's aeronuclear installations. Such a war would be relatively "clean" in the sense that it would claim a limited number of victims, most of them moreover military . . .

Any considerable increase in the number of bases robs this "clean" war of its attractions and renders it difficult if not impossible.

In 1943 Henry A. Wallace, then Vice-President of the United States, although not in a position to foresee all the implications of the present policy of bases, stated that in the event of the United Nations no longer remaining united after having won the war, it would be necessary for the United States to adopt a policy of air supremacy, founded on a strong Air Force and appropriate overseas bases; Wallace went on to say that mastery of the air is impossible without strategic air bases and that the United States should, if necessary, consider the use of force to acquire them.

But the strategy of bases, in its widest sense would also play a leading role in the prevention of minor conflicts.

On the day on which the B-29 "Enoly Gay" launched its atomic bomb the concept of a world police force was created, based on the combination of the atomic bomb, the strategic bomber and encircling bases. Global conflict became impossible because it would trigger the employment of the United States' nuclear arsenal. But it was still possible to indulge in a series of hostile acts which could be serious enough to weaken and divide the West without being sufficiently important to lead to general war. The acts of opposition, hostility, cold war and finally hot war leading up to the fighting in Greece and in Korea, via the Berlin airlift and the conflict in Indo-China, are examples of this principle, since they were clearly "sub-atomic".

Unconsciously, America herself has enlarged the scope of such incidents by insisting on the omnipotence of atomic weapons and revealing, through successive "Bikinis" and "Eniwetoks", the extent of the damage she could inflict. The greater the effects of the bomb, the more serious could be the stakes in local conflicts. This weapon is considered as so terrible that it cannot be used except in the last extremity. It has served to prevent general war, but not local fighting. The Kremlin has been quick to exploit the American concept, seeking to tie use of the atomic bomb to a world war; that is, to irremediable destruction. The Stockholm appeal, for example, was aimed at making the use of such a weapon inconceivable. But as this was the only weapon left to the United States after their hasty demobilization, the field was opened to cold wars and then "luke-warm" wars, generally conducted by intermediaries, that is by the "satellites".

Big weapons for little wars

Within the United States itself the Army and Navy chiefs have not hesitated to attack, at times violently, the USAF's doctrine, criticizing its onesidedness and its inapplicability to any form of conflict more complicated than one in which the "big stick" could be used in face of an open and general aggression by one of the blocs against the other.

On the subject of explosives, Donald Quarles indicated in February 1956, and Mr. Dulles repeated last September that in the event of localized aggression or seemingly minor incidents the American forces would utilize new nuclear projectiles with considerably smaller radioactive effects. But Harold Stassen, U.S. delegate to the disarmament talks, stated last April that the United States Government had never envisaged the use of nuclear weapons in small frontier incidents. The contradiction was no more than apparent. What Mr. Stassen undoubtedly meant was that if the Allies' conventional forces were capable of winning a minor conflict, nuclear arms would not be used. But if, as time went on, the conflict got out of control and appeared to be degenerating into a struggle in which the West, with its limited manpower, was likely to get the worst, "clean" nuclear weapons would come into action. Thus would-be aggressors would be "discouraged" from engaging irresponsibly in any form of war, even of minor importance, since the West would be able to use sufficient conventional or, if required, atomic forces to win the day.

This policy implies the simultaneous possession of the military instruments required to discourage a major aggression and of those necessary for use in a local conflict.

In the first case the required power of destruction is obtained by combining the tremendous power of the nuclear explosive with a small number of carrier vehicles—with due allowance for margin of error.

In the second case, on the other hand, at any rate up to the time of the public statements by Mr. Stassen and Mr. Dulles, the low unit power of destruction had to be multiplied by the largest possible number of carriers.

Now that the use of small caliber nuclear weapons is envisaged for "small" wars, the number of vehicles required can be reduced, and substantial savings realized. Hence the present cuts in the USAF budget. This is also the reason why, despite the cuts, General Twining was able to say last April that the United States is capable of intervening decisively in any conflict touching the country's vital interests. Added to this "discriminating" fire power is the strategic mobility conferred by a substantial force of transport aircraft and the capabilities of a Tactical Air Command maintained in a permanent state of readiness.

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Does the advent of intercontinental ballistic missiles modify this strategy? Not essentially, at any rate as far as the effects of the strategy are concerned, although missiles would fundamentally change the conditions of a conflict. What are these changes?

(a) Active defense, already of low efficiency, becomes valueless, since no anti-missile missile exists.

(b) Attacks on the enemy's launching ramps would have to be substituted for attacks on his air bases. But the number of launching sites can be very much greater than the number of bases, and effective means of passive defense (such as underground installations) can be found in many cases. A war directed against launching sites is even less promising than a war against bases. The only real targets thus left would be large cities. *If these were attacked, however, retaliation would be immediate, and the result would be collective suicide.*

Even if one side had ICBMs and the other merely squadrons of manned aircraft, the balance would not be disturbed provided these squadrons were sufficiently mobile and sufficiently widely dispersed for some of them at any rate to escape destruction. On the other hand the situation would be vastly different if one of the sides possessed not only an adequate stock of ICBMs but also a defensive system that could not be penetrated by the other's reprisal aircraft. Even then, however, the aggressor would have to be certain of his lead, since he could not afford to run the risk of having miscalculated his victim's capacities.

But we have not yet arrived at this situation. The Pentagon experts have wisely decided to continue parallel efforts in both the missile and the piloted aircraft fields, and these two forms of atomic "carrier vehicles" can be expected to exist side by side for a long time to come. The many different aspects of the military threat necessitate a variety of air instruments, both missiles and aircraft. This is what the USAF is aiming at in attacking the heat barrier with piloted aircraft.

USAF

The first authentic representative of the new weapon systems concept, the Northrop SM-62 *Snark* strategic missile. This weapon, complete with ground handling carriage, can be transported by a single Douglas C-124 heavy bomber transport.

America's Weapons for Tomorrow

Following the discussion and illustrations of present-day weapons in these pages, the question naturally arises as to what form the USAF's weapons of the future will take. In spite of the Defense Department's economy cuts, will the USAF receive the weapons necessary to maintain its superiority in the armaments competition of the coming years?

The final answer will probably only emerge when the effects of both the present and the coming military budgets have been clarified. One point is already clear—the USAF is approaching a long transition period leading to the introduction of a series of weapons of a completely new conception. In spite of budgetary considerations the USAF does not appear to be willing to abandon this long-term procurement program. The necessity for economy may become a blessing in disguise, permitting only the most urgent projects to be proceeded with, and demanding concentrated efforts and the cancellation of those projects which are unsatisfactory or duplicate. With the support of Air Research Development Command's research program—reduced but still on a gigantic scale—American industry will doubtless be equal to the task.

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The USAF procurement program for the next few years has been outlined by the Department of the Air Force as follows:

Strategic Air Command

The SM-65 *Atlas* and SM-68 *Titan* ICBMs are to be developed to the operational stage as a matter of urgency, although they will probably not be the only vehicles for nuclear warheads. For some time to come the manned bomber will continue to be the most reliable offensive weapon against certain targets. If the present SAC weapon systems—bomber/tanker teams, B-47/KC-97 and B-52/KC-135—cease to fulfil operational requirements, then successors will be available in the form of a manned supersonic bomber of the B-58 type or the WS-110A weapon system, now under development. The USAF arsenal now includes the already proven SM-62 *Snark* unmanned self guided bomber. Of special significance are air-to-surface missiles developed for employment with the B-47, B-52 and B-58, which permit the parent aircraft to remain outside the enemy's anti-aircraft defenses. It is reported that a first example of this category, the GAM-63 *Rascal*, is to be brought into operational service with a B-47 unit this year. Other air-to-ground weapons, e.g., GM-73 *Green Quail*, are in course of development.

Tactical Air Command

The tactical air arm will continue to have a requirement for fighter-bombers of the F-105 class, with tactical missiles and, by no means least, transport aircraft. Of special importance is Air Materiel Command's missiles logistics program which will ensure a high degree of mobility for all the planned USAF missile units.

Air Defense Command

Generally speaking, no clear picture of the new weapons systems for the air defense of the American continent has yet emerged. It is, however, known that the production program for the Century Series supersonic fighters (F-101, F-102, F-104, and F-106) has been stretched, while production of the unmanned IM-99 *Bomarc* interceptor air-to-air missile is to be speeded up. Also other missiles for air defense are believed to be in development, especially in the field of "anti-missile missiles"—rocket-powered missiles for defense against long-range ballistic missiles.

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The following is a list of the most important weapon projects with some comment on the various stages of development:

● **Republic F-105 fighter bomber:** Designed as a weapon system, the F-105 probably has a maximum speed in the range of Mach 2, and is described as an extremely fast, highly maneuverable A-bomb vehicle, capable of increased ranges with in-flight refueling. The original production program called for approximately 600 of these aircraft for the USAF by 1960/1961, but the cut-back and stretch-out economies imposed early in 1957 will mean that a considerably smaller number will be produced in the period up to 1963. Original planning had also called for quantity production of other versions—the F-105B all-weather, the RF-105 reconnaissance and the F-105C two-seat versions, but the revised program will now concentrate on the F-105A single-seat day fighter which will, however, carry largely automatic navigational and bombing equipment.

● **Martin TM-76 Matador tactical missile:** This weapons system has been developed from the earlier TM-61B and comprises a surface-to-surface missile, with a range of 350 to 400 nautical miles, complete with its own cross-country transporter, launching ramp trailer and the necessary maintenance and ancillary equipment. It is reported that this new weapon will be put into production in the early part of 1958, and it is at present undergoing extensive tests at Holloman AFB in New Mexico. It is also interesting that the TM-76 is reported as having alternative guidance systems, one for low-level tasks and the other for use at altitudes above 40,000 ft.

● **Convair B-58 Hustler supersonic bomber:** In spite of the fact that this aircraft has recently achieved a speed of 1,300 knots (approx. Mach 2.3 at over 30,000 ft.), and is thus far and away the fastest bomber in the West, no plans have been announced for large scale production; this may perhaps be connected with the forthcoming evaluation of the WS-110A weapons system. Present contracts call for the pro-

The Martin TM-76 *Matador* tactical missile is a development of the TM-61B.

The supersonic Republic F-105A fighter-bomber has been designed for speeds up to Mach 2.

duction of 13 B-58s for the USAF, but new contracts for a further 17 are awaited.

● **Northrop SM-62 Snark strategic missile:** The first Strategic Air Command unit to be equipped with the *Snark* will be in operational service by the end of this year, and will initially be employed as a training unit; in this connection it is recalled that the USAF has already announced the formation of the 1st Missile Division at Cooke AFB in California. The new division will carry out a program of training cadre crews for guided missiles. Meanwhile the *Snark* is now in full production, and an improved version with a new guidance system is in course of development.

● **Bell GAM-63 Rascal and GAM-72 Green Quail air-to-surface guided missiles:** For months past the Bell Aircraft Corporation's GAM-63 *Rascal* air-to-surface missile has been undergoing operational testing, and the weapon is now in production, although on a limited scale. The first SAC unit will probably be equipped with the weapon by the end of 1957. While the *Rascal* is primarily intended for Strategic Air Command's B-47s, the GAM-72 *Green Quail* has been specially developed for equipping the B-52, of which a total of 380 should be available by June 1958. North American and Chance Vought are also said to be participating in the USAF design contest for new long-range air-to-surface missiles. In any case the employment of air-to-surface missiles promises the USAF a greatly extended operational life for its long-range manned bombers.

● **SM-65 Atlas (WS-107A-1) ICBM:** Although the first test launching of the *Atlas* on June 11th, 1957, and also the second attempt in September, resulted in failure, increased efforts are being made to achieve the operational production of this approximately 45-ton long-range strategic rocket. However, according to *Aviation Week*, approximately forty SM-65s will be available to SAC by 1959; it is also rumored that roughly a dozen *Atlas* missiles have been completed for test purposes. Main contractors are: Convair Division of General Dynamics for airframes; Rocketdyne Division of North American for power units; General Electric for the nose cone and a part of the guidance system; Burroughs for computers; Arma Division of American Bosch for the inertial guidance system.

● **SM-68 Titan (WS-107A-2) ICBM:** The development program of the *Titan* runs about one year behind that of the *Atlas*, and this weapon will not be ready for first test launching until 1959. On the other hand, the *Titan* is said to have a simplified control and self guidance system which, together with lower production costs, may give the weapon certain advantages over the *Atlas*, when it reaches the production stage. A final decision on the future of both these ICBMs cannot be expected before 1959. The production program, again according to *Aviation Week*, will provide approximately 80 *Titans* for SAC by 1961. Main contractors are: The Martin Company for the airframe; Aerojet-General for the power unit; Avco for the nose cone; Arma Division of American Bosch for the inertial guidance system; Bell Telephone Laboratories for the ground radar; Sperry-Rand for the computers.

● **SM-75 Thor (WS-315A) IRBM:** This weapon also, already in the test launching stage, has suffered some half-dozen test failures. Powered by a liquid propellant rocket motor of approximately 70 tons thrust, the *Thor* should have a range in excess of 1,300 nautical miles.

The Bell GAM-63 *Rascal* supersonic air-to-surface missile, seen here mounted below the fuselage of a B-47, can be launched from outside the range of the enemy's defenses and accurately guided to its target.

At the present time it is impossible to forecast when the SM-75 will be operationally available. In this connection it should not be overlooked that Russian IRBMs are alleged to have been under test since the summer of 1955, and in the last year an average of five IRBM test launchings per month have been carried out; these developments indicate the probability of the weapon now being in production. Main contractors for the *Thor* project are: Douglas for the airframe; Rocketdyne Division of North American for the power units; General Electric for the nose cone; A.C. Electronics Division (General Motors) for the inertial guidance system; Bell Telephone Laboratories for the ground radar; Sperry-Rand for computers.

As a result of the Defense Ministry's economy decisions, a three-man IRBM committee has been set up, which will be responsible for amalgating the USAF project *Thor* with the U.S. Army *Jupiter* program. The *Jupiter* already successfully completed its test launchings in June 1957 and can thus play a contributory role in the further development of the *Thor*. The new project, already christened *Thorpiter*, may do much to eliminate the long-standing controversy over the merits and demerits of the two medium-range rockets. While both the *Thor* and the *Jupiter* are powered by the same Rocketdyne rocket motors, their guidance and ancillary equipment differ considerably.

● **WS-110A supersonic long-range bomber with borane fuel jet engines:** Concentrated efforts are being made in the development of successors for the B-52, and although Boeing and North American are working on separate projects, the same specification applies to both projects and will permit later integration. USAF spokesmen state that this bomber will approach its target at moderate supersonic speed at an operational altitude of over 70,000 ft. and, after launching its missile, will make its getaway at speeds around Mach 4. The main materials used are probably steel and titanium; a supersonic jet engine using borane fuels and producing a static thrust of 11 tons is already in development by Allison (J89), and General Electric is also reported to be working on a similar power unit.

● **WS-125A atomic-powered long-range bomber:** A development program for this long-term project has been cut for the second time within the space of a few years, and only one quarter of the $ 600,000,000 originally estimated will be available in 1958. Lockheed and Convair, engaged on airframes and equipment, and General Electric, on the power units, are particularly affected by the substantial cuts in funds for the project, which is no longer considered of the highest priority.

● **Anti-missile missiles** have been under consideration by the USAF for the past year and now, with the announcement of the new ORDIR (Omnirange Digital Radar) system which will provide considerably increased detection ranges, appear to be a more practical proposition. This system would permit the detection of ballistic missiles at ranges of approximately 2,000 nautical miles, so that the time available for the launching of long-range defensive missiles would be greatly increased. Over and above this it would be possible to intercept the attacking missile near the apex of its trajectory, where its speed would be at a minimum. Obviously many problems of detail remain to be solved before such a weapon is achieved; study of the anti-missile is at present being carried out by Convair in association with RCA, and by Lockheed with Raytheon.

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Alongside these major items, the USAF procurement program for the next few years will obviously include heavy transport aircraft (Douglas C-133A) and assault transports (Lockheed C-130A and C-130B), new radar equipments, fire control systems, etc.—an impressive program involving billions of dollars which will insure the USAF's position as a leading air power. It is clear that within the new armament policy there is little room for radical changes or daring technical experiments; in the words of General E. W. Rawlings, Commander Air Materiel Command, at the Air Force Association Conference at Washington, D.C., on July 31st, 1957... "The transition will be complete when operational unmanned systems push the manned systems from our inventory in the only way they can—by doing the job better."

The West's fastest manned bomber, the Convair B-58 *Hustler*, has been designed to carry a "jettisonable capsule" mounted below the fuselage, for special tasks.

USAF

Global Logistics

AMC and MATS

The dictionary defines the word "logistics" in military usage as "that branch of military science relating to the movement and supplying of armies". When the "army" in question is as big and as world-wide in deployment as the USAF, the task of moving and supplying it inevitably takes on similarly global proportions. Today this task is shared by two independent support organizations:

- *Air Materiel Command,* with headquarters at Wright-Patterson AFB, near Dayton, Ohio, and
- *Military Air Transport Service,* with headquarters at Andrews AFB, Camp Springs, Maryland.

Interavia's two roving reporters visited both headquarters, calling first at AMC, at Ohio's great twin airfields (Wright Field and Patterson Field).

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Colonel Julian B. Cross, Chief of Air Materiel Command's Office of Information Services, received us at the Command's headquarters, where thousands of military and civilian personnel are employed. "We run the biggest business in the world," he told us, "though on a non-profitmaking basis, of course. Altogether we employ something like 220,000 persons. We buy, store and transport around a million and a half different items, from shoelaces to complete aircraft or weapon systems. Our assets today are valued at roughly thirty billion dollars, and 80% of all current contracts for the USAF are awarded and paid for by AMC."

We were then provided with a mass of detailed information, which can be reproduced here only in brief summary form:

• **AMC's mission:** Procurement, distribution and maintenance of all aircraft and equipment items used by the USAF; the performance of countless auxiliary services, such as food supplies, laundry service, memorial affairs (grave registration etc.); procurement and distribution of materiel to more than 30 nations in the Mutual Defense Assistance Pact.

• **Command:** Commander of AMC is *General E. W. Rawlings,* who is assisted by Major General W. F. McKee, Vice-Commander, and Colonel J. T. Kingsley Jr., Chief of Staff.

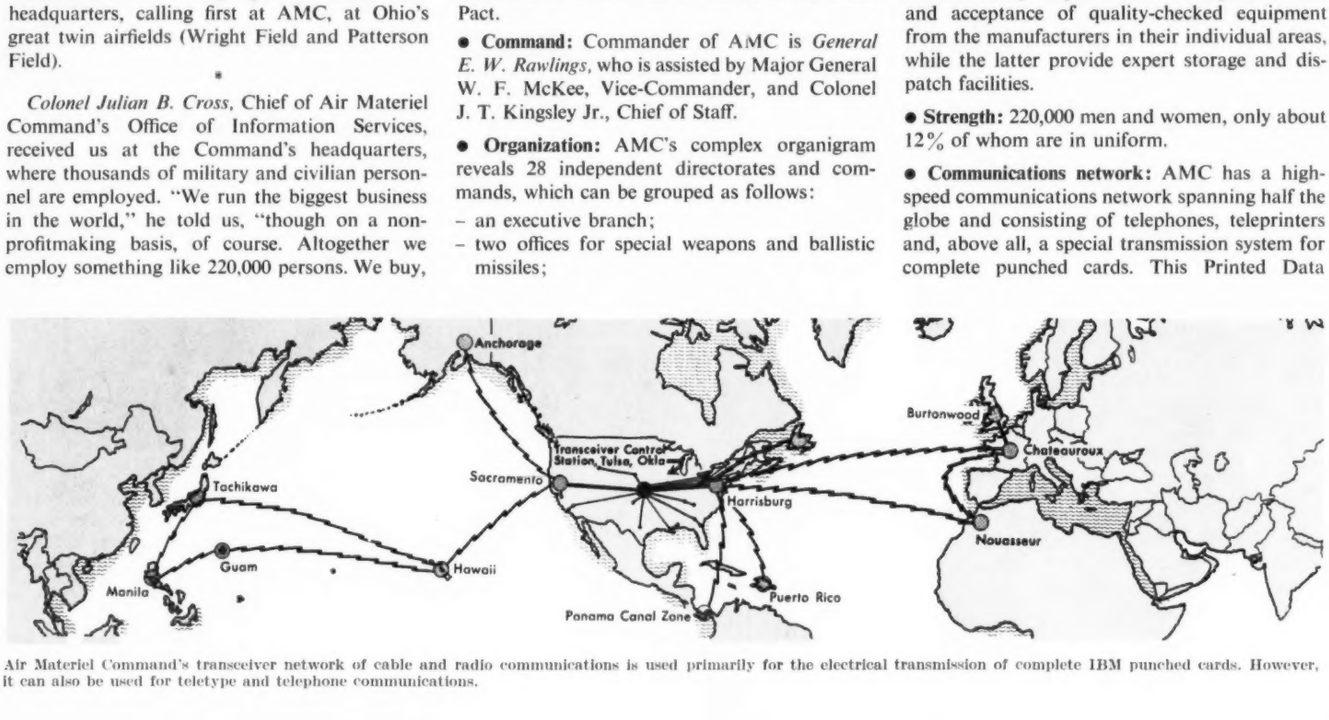
• **Organization:** AMC's complex organigram reveals 28 independent directorates and commands, which can be grouped as follows:

- an executive branch;
- two offices for special weapons and ballistic missiles;
- seven directorates (for procurement and production, supply, maintenance, engineering, transportation and services, personnel and support operations, comptroller, and plans and programs);
- two Air Materiel Forces in overseas areas (one in Europe with three Air Materiel Areas, and one in the Pacific with two AMAs);
- eight Air Materiel Areas on Federal territory;
- seven Air Force Depots on Federal territory;
- one base command at Wright-Patterson AFB;
- one Aviation Depot Wing, also at Wright-Patterson AFB.

A particularly important role is played by the AMAs and Air Force Depots. The former are fundamentally responsible for the procurement and acceptance of quality-checked equipment from the manufacturers in their individual areas, while the latter provide expert storage and dispatch facilities.

• **Strength:** 220,000 men and women, only about 12% of whom are in uniform.

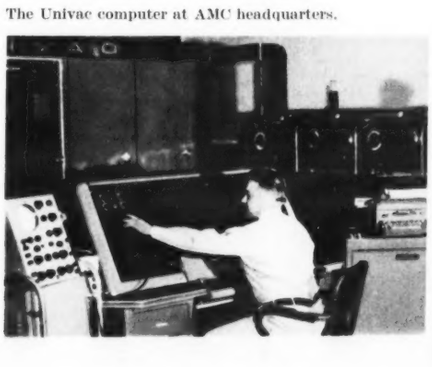
• **Communications network:** AMC has a high-speed communications network spanning half the globe and consisting of telephones, teleprinters and, above all, a special transmission system for complete punched cards. This Printed Data



Air Materiel Command's transceiver network of cable and radio communications is used primarily for the electrical transmission of complete IBM punched cards. However, it can also be used for teletype and telephone communications.

Mechanical conveyor and sorting systems facilitate unloading, storage and dispatch in many AMC depots.

The Univac computer at AMC headquarters.



Transceiver Network (see map) uses telephone and telegraph cables, and radio communications. At each terminal or junction point a set of special desk-size IBM machines either punch out cards on the basis of electrical impulses received, or pass on such cards in the form of electrical signals. With this system it is possible to transmit a request for any spare part, e.g., for a bombsight for an aircraft stationed in Morocco, to the competent Air Force Depot within a few minutes, complete with full details of type number, part number, modification, degree of urgency, cost group, etc. All that is necessary is that the request should be translated into "punched card language". At the receiving end IBM sorting and printing machines turn out ordinary written instructions.

• **Electronic data processing:** The rapid transmission of information, in particular of equipment orders, is supplemented by high-speed electronic computers, memory drums and tape recorders, whose task is to ensure that some categories of spare parts do not suddenly run short, while others, for which there is less demand, flood the stores. For this purpose AMC uses two giant Remington-Rand Univac computers (one at Dayton, Ohio, and the other at Sacramento, California) and several IBM Type 705 computers. These machines are also "consulted" on a great many other questions, such as which of several equivalent aircraft or engine types is the most economical as regards spares and operating life, or what funds will be needed for maintaining stocks of spares in the 1960 fiscal year.

• **Mechanical aids for storage and dispatch:** The reception and dispatch centers at all Air Force Depots are equipped with time and cost saving sorting and packing apparatus, conveyor belts, etc. Special containers have been designed for the packing of delicate or particularly costly equipment such as, for example, the two-piece pressurized engine containers.

• **Air transportation network:** Though the cheapest route is always used for normal transportation purposes, in cases of urgency AMC also makes use of the services of four private airlines which have combined to form a pool known as *Logair*. Not only spare parts but frequently also maintenance and repair specialists are carried by air (equipment: C-46s, C-47s, C-54s). For especially urgent shipments, particularly to overseas destinations, the Military Air Transport Service can also be called upon for assistance.

• **Plans for the future:** AMC is in the process of replanning its organization so as to render it even more efficient in meeting its world-wide responsibilities and to adapt it to the growing complexity of flying equipment. Under the plans

For urgent transport purposes AMC can call on cargo aircraft belonging to four private airlines, which have been formed into the Logair pool.

Items to be transported overseas are packed in watertight fibreboard containers. One of these containers is here seen being weighed at one of the "stops" on the conveyor.

Supplies are normally dispatched by the cheapest route, by road, rail or ship, for which purpose they are packed in special containers known as Conex Boxes.

prepared by *Major General K. E. Tibbetts* (Director of Plans and Programs, AMC), a special Weapon Support Manager will in future be appointed for each weapon system, to be responsible for all supply and maintenance questions. Each of these officers will have his own communications network, his own staffs, depots, computers and air transportation facilities, to ensure that any required spare part for a given weapon system can be transported—within a few days if necessary—to any point on the globe. This system will have the added advantage that the commanders of combat units will no longer be dealing with a more or less anonymous organization, but with a known individual, the Support Manager responsible for their particular weapon system.

*

Our first questions concerned the relatively new concept of "weapon systems" and how far it has already been put into practice. "Which USAF aircraft types can strictly speaking be described as weapon systems and which can not?" The replies seemed to indicate that AMC regards the Convair B-58 *Hustler*, still in the test stage, as the first real weapon system, but admits that the Northrop SM-62 *Snark* and Martin TM-61 *Matador*, though originally planned as independent missiles, were subsequently expanded into weapon systems. However, AMC has already prepared special depots for given weapon systems.

"What is AMC's organization in Europe?"—"Air Materiel Force, European Area, or AMFEA for short, has its headquarters in Wiesbaden and maintains three Air Procurement Offices, in Frankfurt, London and Paris. Ultimate responsibility for off-shore contracts is held by AMFEA in Wiesbaden, while local inspection and support for manufacturers, as well as quality control of goods ordered are the affair of the Air Procurement Offices. Finally, three AMAs provide storage, distribution and maintenance facilities for material acquired locally or received from the United States:

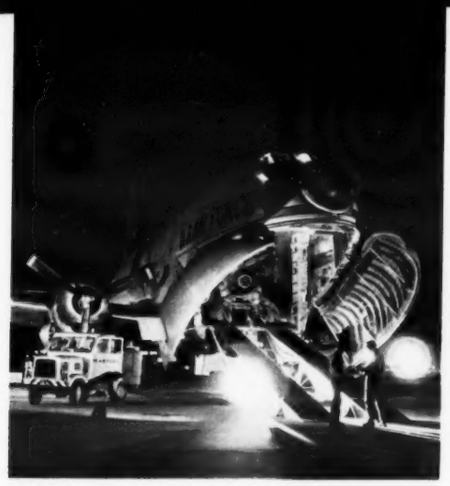
1 – Northern Air Materiel Area, Europe, at Burtonwood, England;
2 – Central Air Materiel Area, Europe, at Chateauroux, France;
3 – Southern Air Materiel Area, Europe, at Nouasseur, Morocco.

The AMC organization in the Pacific region (AMFPA) is built up in similar manner, with headquarters at Tachikawa, Japan. It has, however, only two AMAs, nothern and southern."

*

As already mentioned, AMC's partner in the USAF logistic system is Military Air Transport Service, which works for all armed forces. The

Maintenance and repair of USAF aircraft are among AMC's foremost tasks. Inspecting the jet engines of a Boeing B-52 in Wright-Patterson AFB's repair shops.



MATS' Douglas C-124 *Globemaster 2* transports are ideal for carrying bulky goods, such as missiles, helicopters, complete jet engines (picture).

A MATS Sikorsky H-19 sea rescue helicopter about to be loaded into a Douglas C-124.

MATS' roughly 100,000 nautical mile global network connects all strategic centers in the northern hemisphere (distances given in statute miles).

Seventy-five USAF personnel embarking for England on a MATS Douglas C-74 *Globemaster 1* during a routine rotation of base personnel.

USAF

activities of MATS have been described on several occasions in *Interavia**, and all that is needed here is a summary of the most important facts.

• **MATS' mission:** To maintain a world-wide network of air routes and bases in a constant state of D-Day readiness. Normal peacetime operations—the transport of cargo and passengers, rescue, mail, weather, ferry, photographic and charting services—provide an intensive training program for the strategic mission.

• **Command:** Commander MATS is *Lieutenant General Joseph Smith,* who is assisted by Major General Ernest Moore (Vice Commander), three Division Commanders and four Technical Support Service Commanders.

• **Organization:** MATS comprises three Transport Divisions (Alantic, Continental, Pacific) and four technical services (Airways and Air Communications Service, Air Photographic and Charting Service, Air Rescue Service and Air Weather Service).

• **Strength:** 107,700 military and civilian personnel, including 104,000 provided by the USAF, and 3,700 by the U.S. Navy.

• **Fleet:** Roughly 500 four-engine transports of the following types:

- Douglas C-118 *Liftmaster* (DC-6), for passengers;
- Douglas C-124 *Globemaster 2,* for cargo;
- Lockheed C-121 C *Super Constellation,* for passengers and cargo;
- Boeing C-97 *Stratofreighter,* for passengers and cargo;
- Douglas C-74 *Globemaster,* for passengers and cargo;
- Douglas C-54 *Skymaster,* for passengers, patients and cargo.

Added to these is a considerable number of twin-engine Convair C-131As (Convair-Liners), which are reserved primarily for evacuation services in Federal territory.

• **New flying equipment:** The Douglas C-133A, the first of which was delivered this summer, is now coming into service. Two C-133As have the same transport capacity (measured in ton-nautical miles per hour) as five C-124s or one of World War II's *Liberty* ships.

• **Route network:** Roughly 100,000 nautical miles of non-duplicated air routes to all strategic centers in the northern hemisphere.

• **Reserves:** Within 48 hours of the declaration of a "national emergency" MATS' fleet would be reinforced by more than 300 four-engine aircraft belonging to U.S. airlines, and their crews would enter MATS service.

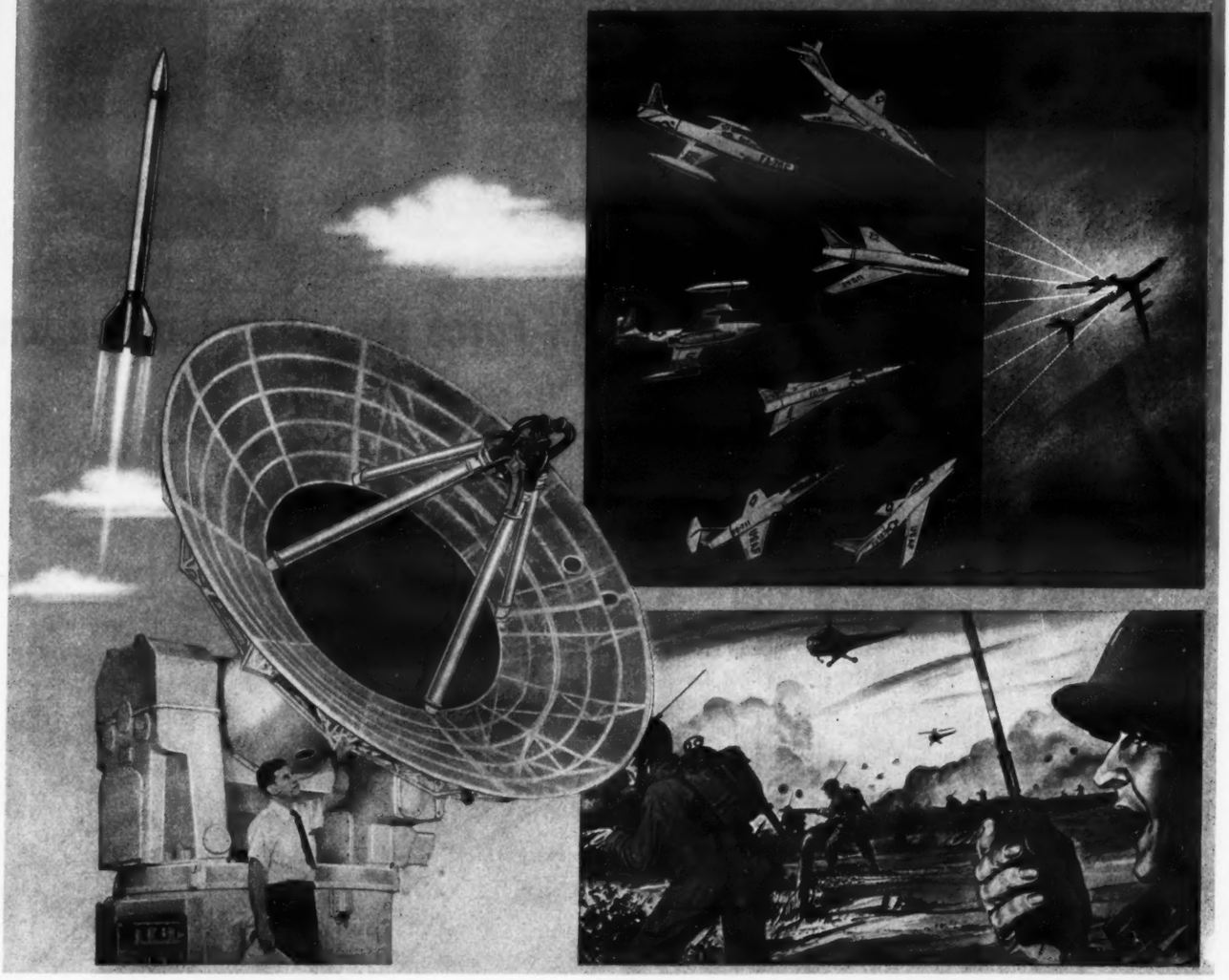
*

In the limited space available here it has not been possible to do more than spotlight the major aspects of the missions, organization and resources of the two global logistics organizations, AMC and MATS. Their prime strategic importance is revealed by the fact that the time required for requisitioning and transporting urgent supplies across the Atlantic, which was still in the region of 100 days during World War II, has now been reduced to approximately 100 hours.

* cf. in particular "MATS – at the Service of All" in *Interavia* No. 2, 1957, p. 114 etc.

Developed and engineered by ***RCA...***

THE MOST ADVANCED ELECTRONIC EQUIPMENT FOR DEFENSE



To the common task of safeguarding the freedom of the Western peoples, RCA brings electronic research, development, and engineering facilities famous around the world. Today, RCA scientists and engineers play a primary role in supplying advanced electronic defense equipments, systems, and components with the highest standards of performance and reliability.

One outstanding example is RCA's AN/FPS-16 *Instrumentation Radar*, which for the first time calibrates and immediately evaluates the behavior pattern of missiles, satellites, drones, and other free space moving targets. Developed specifically for Range Instrumentation, it tracks with accuracy in darkness, through clouds, under any atmospheric conditions, over extended ranges, and yields data that can be reduced almost instantaneously to final form.

Other RCA achievements include *Fire Control Radar*, which gives airmen the far-sighted vision necessary for modern long-range combat operations, telling them *where* to aim and *when* to fire guns, rockets, or missiles; *Personalized Communications*, made possible by modern transistor developments, such as the RCA Transceiver, a complete 2-way FM radio walkie-talkie weighing about 20 ounces, and allowing men in the field to listen to instructions over tiny receiver units built inside their helmets; *Airborne Air Communications* and *Weapons Systems; Forward Scatter*. RCA also offers *Telemetry* for aircraft and guided missiles.

RCA has placed its resources at the disposal of many nations to help strengthen the defense of the free world. Whatever the challenge, RCA's engineering talents and world-wide manufacturing facilities are prepared to assist in every way.

RCA

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AIR TO AIR • AIR TO GROUND • GROUND TO AIR • GROUND TO GROUND

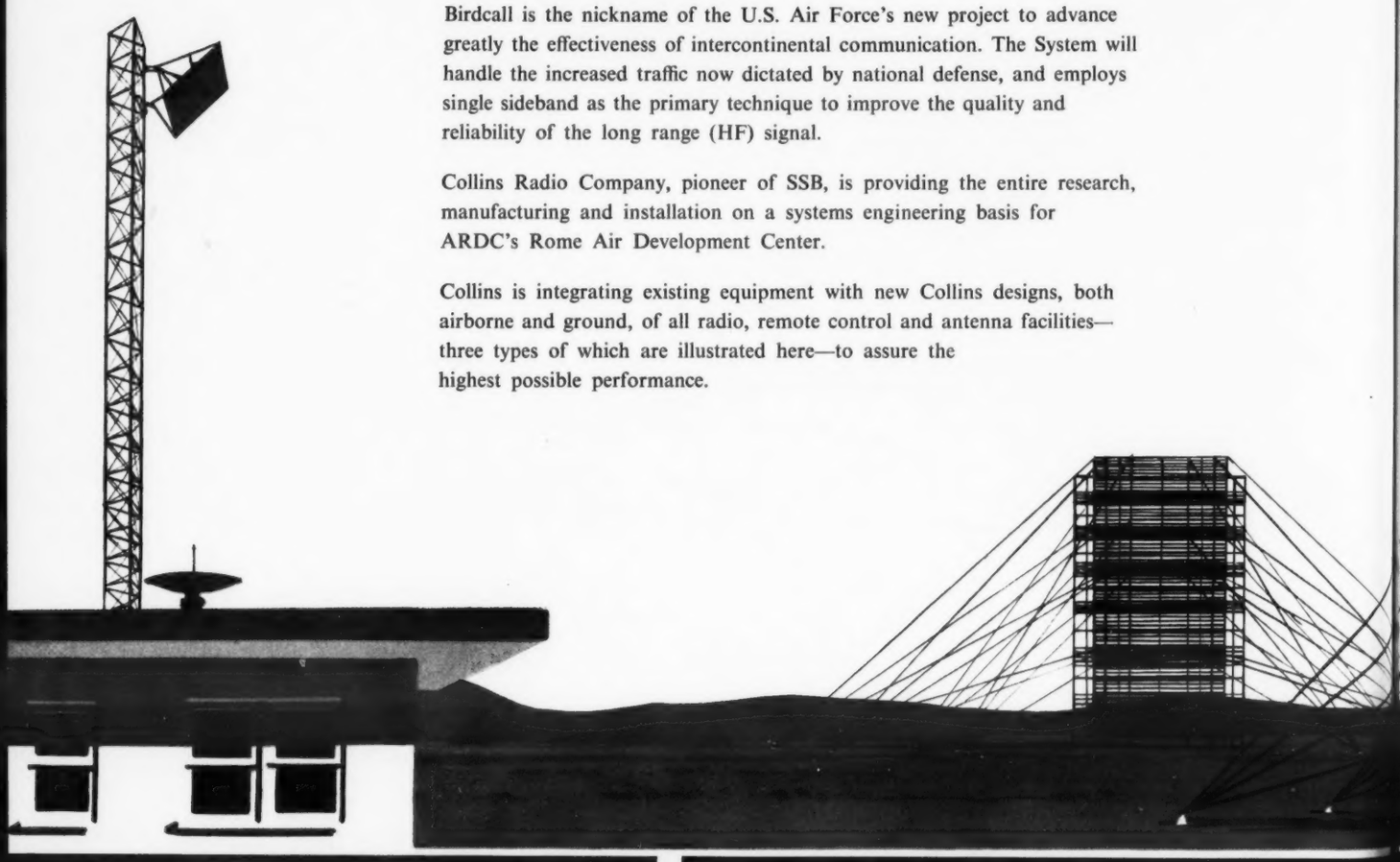
This is BIRD

Single Sideband employed in new Air Force project to improve long ra

Birdcall is the nickname of the U.S. Air Force's new project to advance greatly the effectiveness of intercontinental communication. The System will handle the increased traffic now dictated by national defense, and employs single sideband as the primary technique to improve the quality and reliability of the long range (HF) signal.

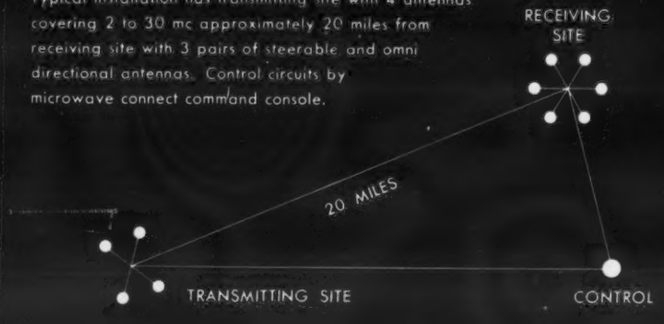
Collins Radio Company, pioneer of SSB, is providing the entire research, manufacturing and installation on a systems engineering basis for ARDC's Rome Air Development Center.

Collins is integrating existing equipment with new Collins designs, both airborne and ground, of all radio, remote control and antenna facilities—three types of which are illustrated here—to assure the highest possible performance.



Transmitting and receiving facilities are the most advanced in the art, many of which represent over 10 years of intensive development in SSB

Typical installation has transmitting site with 4 antennas covering 2 to 30 mc approximately 20 miles from receiving site with 3 pairs of steerable and omni directional antennas. Control circuits by microwave connect command console.



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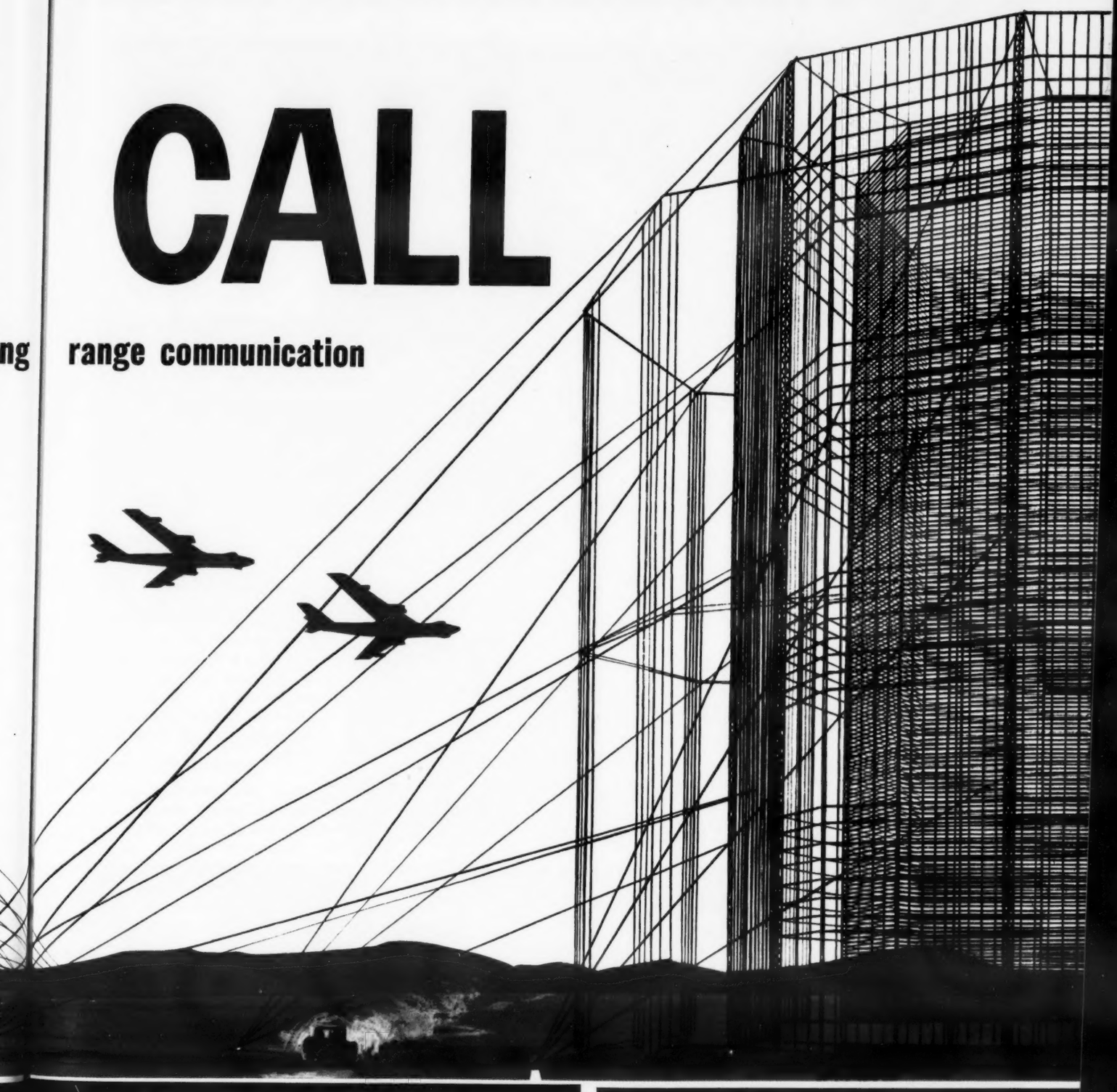
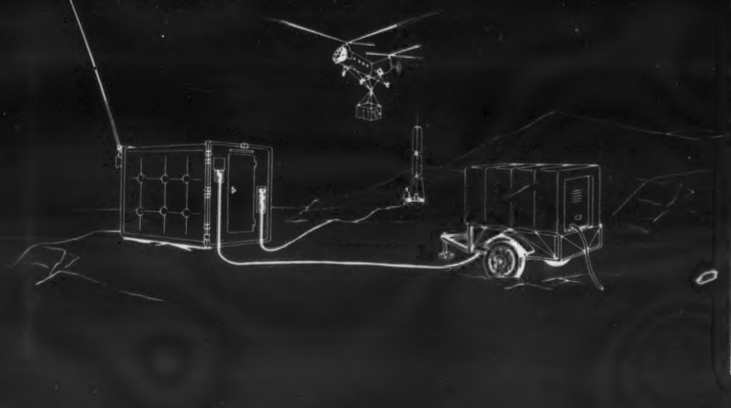
CALL

range communication



Project also includes transportable transmitting and receiving ground units to facilitate field performance.



Collins

COLLINS

Around the World

JETS' TEST DIET

Pratt & Whitney Aircraft's dependable JT3 and JT4 jet engines underwent a series of grueling tests before they could be certificated by the U.S. Civil Aeronautics Administration for use in commercial airliners. They demonstrated the ability to absorb without serious damage such items as lunch pails, rocks, tools, clothing, a variety of fowl and other material. A group of such items, typical of those ingested, are displayed here. Arrow points to 2-inch ice balls fired into the engines' compressor at speeds up to 600 mph, in a simulated severe hailstorm. Airlines around the world have ordered more than 1800 JT3 and JT4 engines for Boeing 707 and Douglas DC-8 airliners.

LARGE PLANT ADDED—A 410,000 square-foot plant addition (circled) is now in operation at Hamilton Standard's main plant in Windsor Locks, Connecticut. The new area is devoted chiefly to engineering and production work on jet engine fuel controls. Hamilton Standard fuel controls are being supplied for all Boeing 707 and Douglas DC-8 jet transports with Pratt & Whitney Aircraft power plants, and for 10 other types of aircraft. Hamilton Standard also recently announced its expansion into the field of aviation electronics.

with United Aircraft

JUNGLE OIL AIRLIFT

Sikorsky S-58 helicopters with 4000-pound payload capacity recently pioneered a far-reaching, new technique in oil drilling operations. They flew all necessary construction equipment, drilling rigs, men and supplies to scattered well sites in jungle areas of wild, mountainous New Guinea, then supported the drilling operations. Costly, time-consuming road construction was not necessary, and only a few months were needed to do the entire rig emplacement job by S-58. It is estimated 18 months would have been needed if ordinary surface transportation had been used. Pictured above, an S-58 brings in a heavy iron skid for a drilling rig engine. At right, an S-58 lands supplies at a drill rig which itself was flown to the site in sections by S-58.

UNITED AIRCRAFT EXPORT CORPORATION *East Hartford 8, Connecticut, U. S. A.*

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For our part, we have been constantly engaged in still further increasing the load-carrying capacity of Timken tapered-roller bearings.

Now, with new and improved methods and machinery at our fine Duston and Daventry factories, we are able to maintain in wide-scale production those refinements in bearing detail design, accuracy and finish which so greatly influence load-carrying capacity.

The resulting increases in rating range from a small to a substantial percentage, according to the particular bearing, and these are shown in a pamphlet which is available on request.

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Vertol helicopter completes longest most northern mission

FM COMDR 55TH AIR RSQ SQ THULE AB GRNLD
TO VERTOL AIRCRAFT CORP MORTON PA
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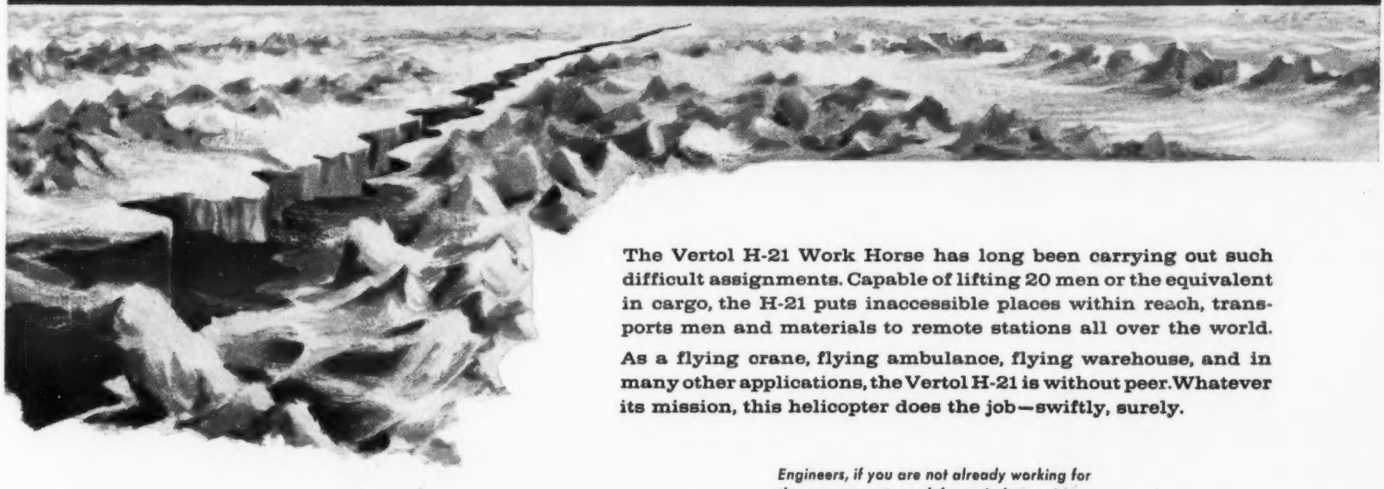
A VERTOL H-21 HELICOPTER MANNED BY THE 55TH AIR RESCUE SQUADRON AT THULE GREENLAND COMPLETED THE FIRST HELICOPTER LANDING EVER MADE ON ICE ISLAND T-3...THE VERTOL H-21 WAS ASSIGNED THE TASK OF EVACUATING TEN CIVILIAN PERSONNEL PD THE TERRAIN ON T-3 WAS SUCH THAT WHEEL OR SKI LANDINGS WERE IMPOSSIBLE PD HOWEVER THE VERTOL H-21 HELICOPTER COMPLETED THE EVACUATION WITHOUT DIFFICULTY PD THIS MISSION IS BELIEVED TO BE THE LONGEST AND MOST NORTHERN EVER ATTEMPTED BY HELICOPTER PD



The Vertol H-21 Work Horse has long been carrying out such difficult assignments. Capable of lifting 20 men or the equivalent in cargo, the H-21 puts inaccessible places within reach, transports men and materials to remote stations all over the world.

As a flying crane, flying ambulance, flying warehouse, and in many other applications, the Vertol H-21 is without peer. Whatever its mission, this helicopter does the job—swiftly, surely.

Engineers, if you are not already working for the government or defense industry, investigate job opportunities with Vertol.

VERTOL Aircraft Corporation

MORTON, PENNSYLVANIA

Air France Publicité ★ J. Starr

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the Super Starliner

A new step forward for AIR FRANCE

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The engines are mounted far from the cabin : quiet and perfect comfort.

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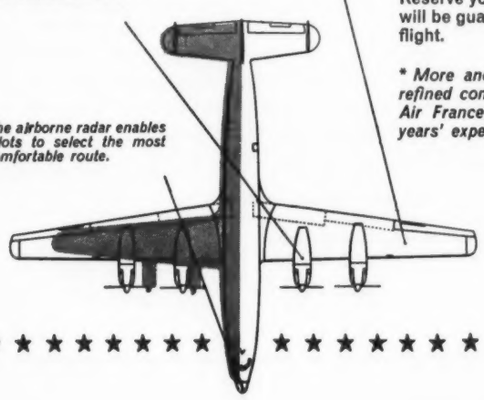

Between Europe, the United States and Mexico, Air France is using the most modern of trans-Atlantic aircraft, the Super Starliner, a new four-engine giant which connects Paris with New York non-stop at 350 m.p.h. !

The Super Starliner's luxurious interiors have been designed by Air France for your pleasure and your comfort. They are definitely modern and reflect the best French taste : the gay and restful colours, the dignified materials and the care given to each detail combine to create a background of elegance and comfort . . .

Reserve your seat now aboard an Air France Super Starliner and you will be guaranteed a pleasant, fast and restful journey . . . an excellent flight.

** More and more travellers—one more every minute—appreciate the refined comfort, attentive service and incomparable cuisine offered by Air France, whose proverbial regularity is the result of thirty-eight years' experience in the service of progress.*

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★ ★ ★

The Distaff Side

By Interavia's Washington Correspondent

One might say the distaff side of the military air power picture actually had its origin at the time of the Civil War when a few feminine auxiliary ground units were assigned to odd jobs, but the arm actually did not come into being until 82 years later when Congress voted it as a separate unit in 1947.

Congressional approval of this separately organized but integrated unit of the air force known as the "Women in the Air Force" immediately led to extensive shifts in the manpower picture.

Today WAF's serve in 43 airmen career fields, 32 of these tailored for enlisted personnel. This peacetime nucleus comprises a mobilization pattern for speedy and orderly expansion of a very much larger female air unit, than the 40,000 air WACs serving with the army during World War II. This was aptly proven a bare four years after its creation when, during the Korean conflict, WAF strength quickly mushroomed to 13,500. Currently the WAFs number 600 officers and 8,000 enlisted women with the active peacetime goal set at approximately 1,000 officers and warrant officers and 8,300 enlisted personnel.

The WAFs, after nearly a decade, are thoroughly entrenched in hundreds of U.S. bases around the world in administrative work, personnel, supply, medical, dental, communications, comptroller, aircraft control and warning, photography, weather, transportation and intelligence, and meteorology, legal and information services. In fact, they take part in just about everything except flying in aircraft engaged in combat. Here Congress drew the line, and about the nearest thing to combat is psychological warfare.

Col. Emma J. Riley, the newly appointed WAF director, who herself came up through the enlisted ranks, says the WAFs are a truly acceptable part of the air arm wherever they are assigned. This goes for both commissioned and enlisted personnel. Since they became a part of the Air Force, the continuous perfection of screening coupled with the vanishing of the old army view, has given the Air Force some highly qualified girls.

Eligibility for enlistment in the air force, either as a regular or as a reservist, requires that a woman be between 18 and 34. If under 21 she must have parental approval. Should she desire later she can qualify for Officer Candidate School or be given a direct commission. More recently some 10 universities have begun training college women through facilities of the Air Force Reserve Officer Training Corps. After the so-called "cadette" has graduated and completed a year of active duty, she is commissioned a second lieutenant in the Air Force.

The USAF's "First Lady". A happy moment for Emma J. Riley, promoted Colonel and Director of the WAF at a Pentagon ceremony. Colonel Riley assumed her appointment on September 1st, 1957.

Women in the Air Force serve in a variety of career fields including their traditional role in the medical services. Flight Nurse training is an essential for such emergencies as the Korean war, where American women served with distinction.

"Anything you can do, we can do better . . .".

Janet Marshall is the first woman member of the WAF Reserve Officer Training Corps.

USAF

The survival kit – here combined with rubber dingy – is standard equipment for all flying personnel.

Four-fifths of all USAF pilots will be drawn from the Reserve Officer Training Corps Program of the American colleges and universities. At the University of Alabama the courses are run in conjunction with a civil flying school which trains cadets to private pilot's licenses.

Top: Candidates for Air Training Command are also recruited from the Military Academies at Denver, (US Air Force Academy), West Point and Annapolis, and from enlisted personnel and officers. *Bottom:* ATC also trains many officers and NCOs from Allied Air Forces (Allied Trainees): German flying pupils learn English at Lackland AFB.

Four Stars in every Survival Kit...

The U.S. Air Force Training and Professional Education Program

Napoleon, Emperor of the French, is popularly credited with the promise that every soldier carries a Field Marshal's baton in his knapsack. This maxim is particularly apt when applied to the USAF today although it has no Field Marshals—only one to four-star Generals—and haversacks are no longer fashionable. Indeed every American airman has the basic opportunity for reaching officer rank and can, if suitably qualified with both physical and mental aptitudes, become a pilot or navigator; and within the reach of every officer are those General's stars . . . symbolically, in the item of equipment from which no man on operational flying duty may become separated—the survival kit.[1]

In the USAF all pilots and navigators are of officer rank. A second lieutenant's commission is granted, if not already held, at the same time that a man receives his "wings". Obviously not all commissioned officers are pilots, and Air Force commissions are granted to men in many other fields, e. g., Engineering, Medicine, Law and Administration, etc.

Shown below, in simplified diagram form, is the complicated network of training and educational processes through which a recruit can eventually achieve four-star General rank. This diagram illustrates well the five broad phases of the USAF system: A = Initiation; B = Air Training Command; C = USAF Combat Units; D = Air University institutions; E = staff colleges, under the direct control of the Joint Chiefs of Staff. The most important stages in this process, the *Air Training Command* and the *Air University*, are shaded grey, and are discussed in detail below.

[1] The Survival Kit contains emergency rations, fishing and cooking gear, matches, first-aid equipment, etc, and permits flying personnel who have made emergency landings or ejections to survive under primitive conditions. This kit is normally attached to each ejector seat.

Air Training Command

It is the responsibility of Air Training Command to maintain a flow of trained pilots, navigators and technical specialists, to satisfy the Air Force's requirements. Under the command of *Lt. Gen. Charles T. Myers* ATC's work can be divided into three main sectors:

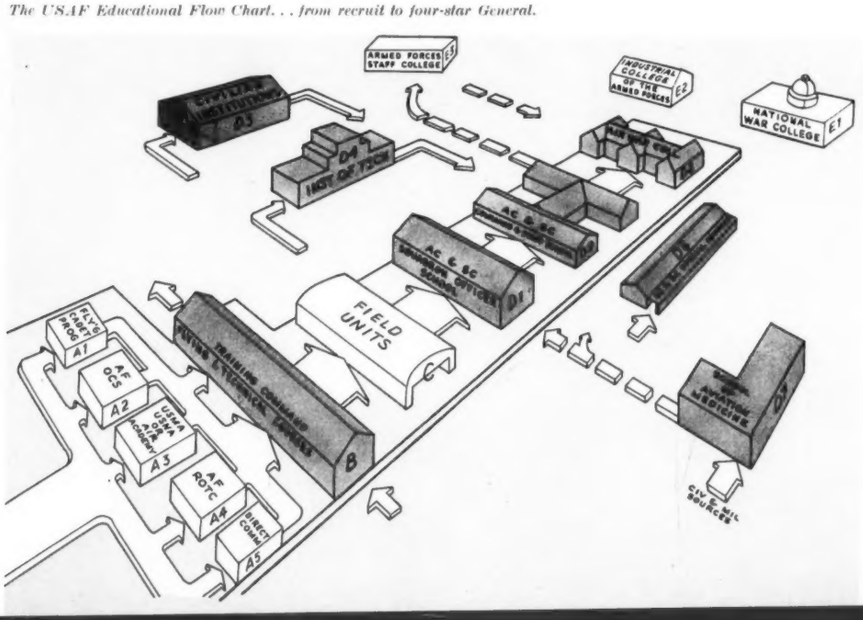
1. *Basic Military Training at Lackland AFB*, near San Antonio, Texas, where the military preparation of all candidates for further flying or technical training is carried out.

2. *Flying Training Air Force* (Fly TAF), with headquarters at Randolph AFB, near San Antonio, Texas, responsible for the flying training of pilots and navigators.

3. *Technical Training Air Force* (Tech TAF), with headquarters at Biloxi, Mississippi, responsible for the technical training of specialists.

In order to appreciate the various manpower sources for ATC recruiting programs, a further explanation of the "educational flow chart" is necessary: *Block A1* represents candidates from enlisted men and civilians under the Aviation Cadet Program; *Block A2* refers to the Air Force Officer Candidate School; *Block A3* shows gra-

The USAF Educational Flow Chart. . . from recruit to four-star General.



duated second lieutenants from Army, Navy and Air Force Academies;[2] *Block A4* represents the largest percentage intake, the graduate second lieutenants from the AF Reserve Officer Training Corps, conducted at 179 civilian colleges and universities by the Air University; *Block A5* refers to the procedure whereby certain highly skilled persons, e. g., doctors and scientists, are granted direct commissions.

Under the ATC system enlisted personnel candidates are given the title *Aviation Cadet*, while officers are known as *Student Officers*. Over and above this ATC also handles officers and N.C.O.s from allied forces who are listed as *Allied Trainees*.

*

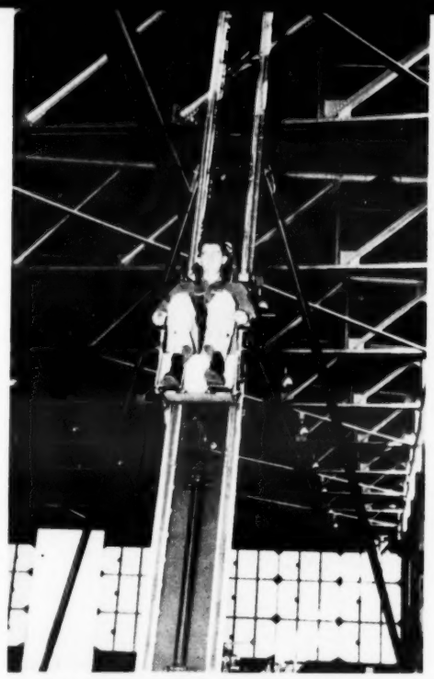
All new entrants are first required to undergo thorough *Basic Military Training at Lackland AFB, the "Gateway to the Air Force"*, in courses decided by the pupils' previous military history. Aviation Cadets, for example take a twelve-week course during which the basic facts of military life and discipline are drilled into them, while Student Officers undergo a milder six weeks course with the general emphasis on theoretical indoctrination. For Allied Trainees, mostly young officers from countries allied with the United States, basic training at Lackland requires a 12 to 18 week period to include the highly concentrated English course given by the *U. S. Air Force Language School*.

The most decisive results in the English language instruction are achieved electronically, with the aid of a battery of twin-track magnetic tape-recorders, which have been developed for the school by the Electronic Teaching Laboratory, Lackland. Pupils are handled in groups of ten to twenty and each man is provided with a tape-recorder, earphones and a microphone. A button sets the "Instructor" in motion—the Master Tape—which reproduces for the student first simple phrases in English, leading to more complicated phrases. The student is required to repeat these phrases into the microphone for recording on the second tape—Student's Tape. At the end of each session both tapes are played back together, enabling the student to compare his recording with the Master Tape, and to spot and correct his errors. Parallel to this instruction more formalized teaching is given, especially reading exercises, instruction in technical English, and in everyday American military and civil usage.

"To date we have trained almost 5,000 pupils from 42 nations", explained Edward A. Brandes, Director of the Language School's Curriculum Branch. "They remain under instruction with us until they have achieved the instruction target of ECL 70. ECL is English Comprehension Level, and ECL 100 represents the vocabulary of an average American college man with an interest in flying. We establish the degree of proficiency in English of our pupils, measured in ECL, by use of a fairly complicated test system; a pupil is required to have a preliminary knowledge averaging ECL 40, and will have to reach a standard of ECL 80 to undergo Advanced Flying Training; for Primary Flying Training we cannot accept a standard lower than ECL 70."

*

[2] U.S. Military Academy, West Point, New York, U.S. Naval Academy, Annapolis, Maryland, and U.S. Air Force Academy, Denver, Colorado. Until the first USAF Academy class graduates in 1959, entrants are only from West Point and Annapolis.



Simulated bailout in the ejection seat training rig at Air University, Gunter AFB, Alabama.

Fly TAF's Primary Pilot Training Program is carried through by civilian flying instructors, mainly in North American T-28 piston-engine trainers.

On completion of military and, if necessary, language training at Lackland AFB, the candidates move on to *Flying Training Air Force (Fly TAF)* and undertake staged flying or navigational training. Pilots are posted into one of the seven Primary Training Schools, and Navigators to one of the two Primary-Basic Navigator Training Schools, controlled by ATC. All these schools, and also the advanced training establishments, are located in the south and south-eastern States of America, where optimum weather conditions prevail.

Pilot Training Program of «Fly TAF»

The flying training of both American and Allied pilots is managed in three progressive stages:

1. Primary Pilot Training.
2. Basic Pilot Training.
3. Advanced Pilot Training.

The first stage, *Primary Pilot Training*, is carried out by civilian schools and instructors under contract to, and under monitoring by the USAF. For their part the USAF provides the aircraft—Beech T-34 two-seat trainers (225 hp) and North American T-28 two-seat trainers (800 hp)—and is responsible for the administration and discipline of the trainees, and for military drill. At the present time ATC has seven such schools, located at Bainbridge and Spence in Georgia; Bartow and Graham in Florida; Hondo and Moore in Texas; and Malden, Missouri. The Primary course requires six months and normally provides 130 hours of flying (30 hours T-34 and 100 hours T-28, of which approximately one-third is in solo flight), together with 226 hours of theoretical instruction, and about 150 hours military training. Each school has available an average of 35 T-34s and 114 T-28s and, apart from a thorough grounding in routine flying training, each pilot trainee is exercised in aerobatics, instrument flying and navigation. Each of the seven bases handles eight classes of approximately 112 trainees in a year, and the total facility is thus for approximately 6,300 pilots per annum; the cost of training each pilot is given by the USAF as $8,926. From this program 80 % of the pupils are accepted for further training, and the attrition rate, from various causes, is 20 %.

The successful graduates from Primary training are drafted to *Basic Pilot Training Schools* for military training, carried out by ATC at seven

Breaking the Language Barrier: Almost 5,000 officers and NCOs from 42 nations have been instructed in aeronautical English at the *USAF Language School* at Lackland AFB.

USAF
Today
Phase 1: Beech T-34, cruising speed 120 kn.
Tomorrow
Phase 2: North American T-28, cruising speed 160 kn.
Phase 3: Lockheed T-33, cruising speed 300 kn.
Phase 4: Republic F-84F, cruising speed 450 kn.
Operational: e.g. North American F-100C, supersonic speeds.
Phase 2: Cessna T-37, cruising speed 300 kn.
Phase 3: Northrop T-38, supersonic speeds.
Operational: e.g. Lockheed F-104, supersonic speeds.

A glimpse of the future: The present training system for USAF pilots (top row) will be simplified with the bringing into service of the new Cessna T-37 and Northrop T-38 jet trainers.

AFBs located at: Bryan, Laredo, Webb, Goodfellow and Reese in Texas; Greenville, Mississippi; and Vance, Oklahama. Here the trainee is given 82 hours dual and 23 hours solo flight training on either the Lockheed T-33 two-seat jet trainer or the North American TB-25 twin-engine (piston) crew trainer. The course, lasting six months, provides an additional 185 hours of theoretical instruction and 190 hours military training. On successful completion of the Basic Pilot Course, in which the attrition rate is only 10 %, the student gains his wings and becomes a Pilot of the Air Force and, if not already held, is commissioned as second lieutenant. The cost per man is $22,767 for jet training, or $18,915 for TB-25 training.

An average 42 % of graduates from Basic Pilot Training are drafted to the third stage in the Fly TAF Program—*Advanced Pilot Training*—the remainder being posted direct to USAF Combat Units where they undergo further operational training. Advanced Training is of various types and requires periods ranging from two to five months; typical examples are *Day Fighter* Training (T-33; F-86F; F-100A) embracing 116 flying hours and 137 hours of theoretical instruction, at an average cost of approximately $40,000 per officer; *All-Weather Interceptor Training* (T-33; F-86D) embracing 117 flying hours and 139 hours theory, average cost $35,000 per officer. In addition Advanced Training provides special courses for Tanker Crew Training in KC-97s, Medium Bombardment Training in B-47s, and Helicopter Pilot Training in H-19s and H-21s. ATC at present maintains seven Advanced Training Bases at AFBs: Luke and Williams in Arizona; McConnell, Kansas; Moody, Georgia; Nellis, Nevada; and Perrin and Randolph in Texas.

An average pilot spends some 20 months in the Fly TAF "pipe-line" and his training costs the American taxpayer an average total of $67,300. The reasons for the recent decision to extend periods of service for flying personnel to five years are clearly understandable.

The Navigator Training Program of Fly TAF

On assignment from Pre-Flight Training at Lackland, the navigator candidates follow a similar process of Primary-Basic, Advanced and Crew Training.

The first stage, *Primary-Basic Navigator Training Schools* are operated at Ellington AFB, and Harlingen AFB, both in Texas, where candidates are given 160 hours flying instruction in Convair T-29 twin-engine Navigational Trainers, together with 559 hours of classroom instruction in Map Reading, Dead Reckoning Navigation, Radio Navigation (including Loran and Radar), Celestial Navigation—Day and Night, Pressure Differential Flying (for long-range flights), and Grid Navigation (for Polar flights). The ancillary subjects of military drill, tactical and strategic principles are also covered. On the completion of the eight-months course the graduate receives his Navigator's Wings and a second lieutenant's commission, and is assigned either to USAF operational units, or to Advanced Navigational Training. The attrition rate for this course is fairly high at 15 % for Student Officers and 30 % for Aviation Cadets; the per capita cost is $17,000.

Advanced Navigator Training requires a five to ten-month period of instruction and is firstly concerned with proficiency in the use of bombing and reconnaissance techniques, closely integrated with the employment of airborne radar; further instruction is given in the employment of ECM (Electronic Counter Measures) equipment and techniques.[3] This instruction is carried out at the AFBs at Keesler, Mississippi; Mather, California; and James Connally, Texas. Other graduates from Primary-Basic Navigator Training are drafted direct to Randolph AFBs *KC-97 Crew Training Program.* A percentage of graduates from Advanced Navigator Training are posted to special B-47 Crew Training at McConnell AFB, before proceeding to operational units.

Specialists Training with Tech TAF

Technical Training Air Force (Tech TAF) is responsible for the training of airframe and engine mechanics, meteorologists, radio and radar specialists as well as missiles technicians. Tech TAF's Schools are located in Chanute AFB, Illinois; Keesler AFB, Mississippi; Lowry AFB, Colorado; Scott AFB, Illinois; and Sheppard AFB, Texas. On the other hand Engineering Officers are trained at Air University's Air Force Institute of Technology.

The buildings of the Air University at Maxwell AFB, Montgomery, Alabama: In the centre is the Library with (below right) the Squadron Officer School, and (below left) the Command and Staff School. The buildings on the left of the picture are student's quarters.

The Air University

The internationally known USAF Air University—which every officer reaching for the higher appointments must enter—is, in fact, a complex of schools and institutions, as is shown by the schematic "educational flow chart" accompanying this article.

1. *The Squadron Officer School at Maxwell AFB, Montgomery, Alabama* for selected Lieutenants and Captains under 35 years of age, and with between three and eight years service.

[3] The offensive and defensive developments in the "Electronic War" are State Secrets of the first order. In no single instance has it been possible for an outsider to obtain an exact definition of Electronic Counter Measures.

2. *The Command and Staff School at Maxwell AFB,* for Majors and Lieutenant Colonels.

3. *The Air War College at Maxwell AFB* the senior Staff College of the USAF for Colonels.

4. *The Air Force Institute of Technology at Wright-Patterson AFB, Dayton, Ohio,* for technical officers.

5. *Special courses* at various civilian colleges and universities.

6. *The School of Aviation Medicine at Randolph AFB, San Antonio, Texas and at Gunter AFB, Montgomery, Alabama,* a specialist school for Air Force doctors, and for research on aviation medicine.

Parallel to these facilities the Air University also administers the *Air Force Reserve Officer Training Corps (ROTC)* Program in 179 civilian colleges and universities, with the primary mission to qualify highly selected cadets to become officers in the USAF. *Air University* headquarters are at Maxwell AFB, under command of *Lieutenant General Dean C. Strother.*

*

But the Air University is not concerned only with providing a seat of learning for the tactical, strategic or technical arts of air power. Over and above this charter, Air University is also a Research Center for every aspect of air warfare, and has established a principle of not only permitting, but actively stimulating independent thinking and mental processes—something of an innovation in military history!

The basic concepts of the system are:

1. Academic freedom, in that every student officer has complete freedom to criticise any given theory.

2. The avoidance of traditionalism by concentrating on a pre-next war and not a post-war system.

3. The encouragement of unfettered originality and the avoidance of "approved solutions". That is, education rather than instinct training.

4. To establish the Air Force as an instrument for maintaining peace, but with instant readiness to perform its wartime mission.

Of the three tactical schools within the Air University, it is only possible here to discuss in further detail the *Air War College,* which is responsible for the further professional education of Colonels with between thirteen and eighteen years service. Of each intake approximately 80 % are USAF Colonels, the remaining 20 % comprising members of the U. S. Army, U. S. Navy, U. S. Marines, the Royal Air Force, and the Royal Canadian Air Force, together with a few Civil Servants from, for example, the State Department or the Central Intelligence Agency (CIA). The curriculum provides a ten-month course for 160 students, during which complete academic freedom for discussion between instructors and pupils exists, and covers the fields of International Relations (12 weeks), the Concepts and Employment of Air Warfare (19½ weeks), and Future Global Strategy (9 weeks). Particular value is placed on the development of a realistic estimate of the national and world situation, and the application of these and other considerations to current strategy and future warfare in the attainment of national objectives.

Officers of all three services (and U.S. Marines) participate in the ten-month courses offered at the Air War College.

"Students have freedom to disagree freely and frankly". Air University basic policy.

Apprentice pharmacy specialists at the School of Aviation Medicine, Gunter AFB.

The School of Aviation Medicine is also a Research Center. A new device to measure hyperventilation (heavy breathing through anxiety) in student flyers is fitted to the instructor's seat in a Lockheed T-33 jet trainer.

Available to students at both the Air War College and the two junior tactical schools is the *Air University Library* containing, under one roof, classified and non-classified material, films, maps and pictorial facilities, together with the recorded results of the work of the closely associated *Research Studies Institute.* The latter, with its three divisions: Historical; the Arctic, Desert and Tropic Information Center; and Documentary Research, collects, evaluates and disseminates a wealth of material on every subject of interest to the Air Force.

The *Air Force Institute of Technology* at Wright-Patterson AFB has for its charter the advanced technical training of officers in the fields of aeronautical, electronic and armament engineering, industrial management and administration. The Resident Instruction Division offers one or two-year courses with baccalaureate degrees, while the Civilian Institutions Program utilizes the services of civilian universities, industries and other governmental branches.

An additional specialist branch of the Air University is the *School of Aviation Medicine,* with an impressive faculty roll, responsible not only for the training of Air Force physicians, Air Force and Navy nurses and medical technicians, but also for the study of aviation medicine in general. Headquarters are at Randolph AFB, Texas, where the principal instruction comprises two graduate courses for selected medical officers; the first, a Primary Course in the basic principles of aviation medicine is a nine-week introduction to the speciality, given four times during the year, with a quota of 115 medical officers in each class; the second is an Advanced Course covering a period of 47 weeks for a quota of 10 medical officers. At the Gunter AFB branch the School offers over 40 courses for newly-commissioned officers of the AF Medical Services, Flights Nurses and airmen in a wide of medical subjects and administration.

Commandant of the School is Major General Otis O. Benson Jr., M. D. who has as his deputy Colonel Robert H. Blount, M. D. The School takes great pride in the fact that, alongside routine medical instruction, considerable research work, in intimate association with ARDC, is carried out, more recently in particular in the field of very high altitude crew protection. For this latter program Hubertus Strughold, M.D., Ph.D., a pioneer in German aviation medicine and now Adviser for Research to the School, has developed a hermetically sealed cabin simulator which has been of the highest value.

*

The detailed training facilities and programs of the Air Training Command and Air University are essential stages in the aeronautical, technical and medical professional education of officers from junior ranks up to Staff grade; the final steps on the road to the General's stars lead through three top level schools under the control of the Joint Chiefs of Staff: *The Armed Forces Staff College* in Norfolk, Virginia, for Tactics and Strategy; *The Industrial College of the Armed Forces* in Washington, specializing in Management and Industrial courses.

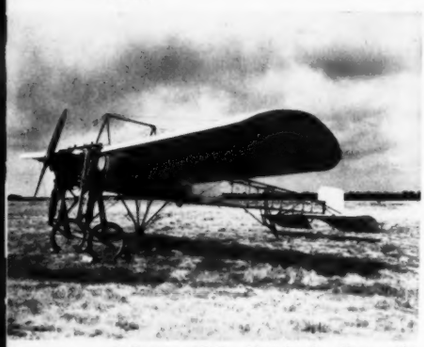
At the summit of the "Educational Flow Chart", the *National War College* at Fort Lesley J. McNair in Washington, D. C., provides highest level training in the techniques and tactics of joint service operations which are accepted basic principles in the art of war.

USAF

Seven Weeks in America

BY DR. H. RIECK, GENEVA

Washington D.C.: Capitol and George Washington Memorial (obelisk in the rear).



Andrews AFB, Maryland: From the reconstructed 1909 Bleriot (with Continental engine; pilot Frank Tallman)... ...to the Ryan X-13 VTOL aircraft (pilot Peter Girard), the Golden Anniversary Air Show offered an impressive review of 50 years of flying.

The C-45 crew: Major Wengel, aircraft captain (center right) and Major Allen, co-pilot (center left), flanked by First Lieutenant Perkins and Harry Tennant. *Below, the Pentagon.*

"You will see for yourself", said my charming hostess at one of the two dozen parties in Washington, D.C., "... this country is a whole continent!"—I was soon to discover for myself how right she was: my twelve-hour flight across the Atlantic from Lisbon to New York—comfortably installed in one of Swissair's DC-7Cs and with five extra hours thrown in due to the time difference—soon apeared to me as a short hop, compared with the tour which followed. This trip took me to almost every corner of the United States, over 8,500 miles by air and some 600 miles by car, with a tight daily schedule of visits to USAF installations or aircraft manufacturers ... without air travel a clearly impossible program.

However, there was plenty of air transportation available, ranging from the Air Force shuttle services (generally C-47s), through a USAF liaison aircraft (Beech C-45H) which made something of a detour for *Interavia*'s benefit, to the coach and first class services of scheduled U.S. air carriers. Moreover I was fortunate to find within *Interavia*'s American organization competent guides to shepherd me around. As soon as I arrived in Washington I was taken in charge by *Harry Tennant*, Editorial Director for the U.S.A., who accompanied me on all my Air Force visits, even to far-off Mojave Desert. In the Los Angeles and San Diego areas I visited the aircraft industry in the company of West Coast correspondent *Norman Lynn* (in some cases also of *Jim Galloway*), and in the New York area—including Hartford, Bridgeport and Philadelphia—*Charles "Bud" Soden, Interavia*'s East Coast representative, acted as chaperon. This "escort system" had the added advantage of providing me, at the most important points of the itinerary, with that indispensable means of local transport, without which present-day life would be unthinkable, the automobile.

My first introduction to American air power took place in Washington, or more accurately at near-by Andrews AFB in Maryland, where the *Golden Anniversary Air Show* was staged to some 75,000 spectators on July 28th, 1957. The program included precision formation flying by Tactical Air Command and Strategic Air Command bombers, namely six Martin B-57s and six Douglas B-66s followed by twelve Boeing B-47s, also a KC-135 jet tanker refueling a B-52 and a KB-50 refueling three F-100s; finally demonstrations by Century Series fighters, F-100, F-101, F-102, F-104 and F-105. These displays were supplemented by an aerobatics program by the *Thunderbird* team (on F-100s) and an impressive historical review covering the whole range of aircraft from airworthy copies of 1909—10 Bleriot and Curtiss models to the amazing Ryan X-13 VTOL aircraft.

Next I presented myself to my hosts at the *Pentagon*, without whose active sponsorship the tour to USAF bases would not have been possible; in particular to *Major General Arno H. Luehman*, Chief of Information Services USAF, and *Colonel F. Clarke Newlon*, his righthand man, also *Major Tim Dunn*, Head of the Books and Magazines section, and *Colonel Howard L. Burris*, Chief, Foreign Liaison Office and until recently U.S. Air Attaché in Berne. I was immediately struck by the ease with which anyone can enter this vast five-sided office fortress and penetrate to the top officials of the various departments or to the desk of any one of their some 30,000 subordinates. There is no checking of passes in the Pentagon! "An unnecessary formality", said Colonel Burris. "During the war, of course, we all had our identity cards. But one of my colleagues had the bright idea of sticking a photograph of Adolf Hitler on his pass and still regularly got past the guards unchallenged."

Washington was the center from which we made our series of trips to *Air Materiel Command* at Dayton, Ohio (400 miles west), *Tactical Air Command* at Langley AFB, Virginia (120 miles south) and *Air Research Development Command* at Baltimore, Maryland (45 miles north). These visits are described elsewhere, and a few words on the Federal capital will suffice to complete the picture. Washington is a handsome city, generously laid out with relatively low houses (not more than twelve storeys high), numerous parks and rows of trees along its streets. A particularly striking feature is the total absence of wires and cables above ground level; even the streetcars take their power from

buried rails. The city's population numbers roughly 800,000 of whom nearly 44% are colored. Typical features of the surrounding country are the tobacco and corn fields of hilly Virginia and Maryland, through which run broad four-to-six-lane highways.

A whole chapter could be written on the capital's trying climate, above all the sub-tropical heat and humidity of the summer months. Good air conditioning systems are essential to ensure normal working efficiency or even a reasonably comfortable existence. I was told that further south, in Oklahoma and Arkansas, even the cow-sheds are air-conditioned and that the cows pay for the luxury with a higher milk yield. Road traffic in and around Washington is more than heavy. It is often difficult—and always costly—to find a parking place even in the multi-storey garages. The visitor is also struck by a degree of inflexibility in the flow of traffic; everyone drives stubbornly on, without regard for the problems of his neighbour who is trying to turn left or right . . . "Here I would drive around in an armoured car", I once exclaimed in exasperation.

*

After two weeks in Washington I finally set off westward with Harry Tennant. We drove out to Bolling AFB and climbed aboard the six-seat Beech C-45H *Expeditor* mentioned earlier. Our hosts—Major Emil Wengel, the aircraft's captain, Major Richard Allen, co-pilot, and First Lieutenant James Perkins — were excellent companions, and the tour was to be both interesting and amusing. It started, however, with five long hours of IFR flight, sometimes through thick cloud, to the neighbourhood of Terre Haute (pronounced Terryho), Indiana. A thunderstorm put the radio compass out of action, but fortunately a gap appeared in the clouds, to enable the crew to carry on according to schedule to Chanute AFB, near Rantoul, Illinois, on VFR. We filled up the C-45 with gasoline and our empty stomachs with lunch, and then set off on the remaining three hours' flight to Offutt AFB, near Omaha, Nebraska, where we made our overnight stop.

Our impressions of Offutt AFB, headquarters of Strategic Air Command, and SAC's neighboring Lincoln AFB are described in the article entitled "Sword, Shield and a Mailed First". From Lincoln the C-45, helped by strong tail winds, carried us in a bare three hours to Lowry AFB, near Denver, Colorado, on the fringe of the towering Rocky Mountains and thus at last into cooler regions. We visited the temporary classrooms and quarters of the Air Force Academy at Lowry, saluted from the air the Academy's future home 50 miles further south and finally landed at Peterson Field, city airport for Colorado Springs.

After briefings and a quick tour of inspection at the headquarters of Air Defense Command and NORAD (North American Air Defense Command), our journey continued—towards the eerie lunar wastes of New Mexico. Actually the change of scene was gradual. First we followed the stretch of the Sangre de Cristo Mountains, a chain of blue-green peaks rising at times to 14,000 ft. beyond the yellowish prairies of the Great Plains. The dominant color then changed to a reddish hue, broken by the thin green lines of the valleys. Another fifteen minutes and we were flying over the chalk-white salt lakes of Laguna del Perro . . . the "dog swamp", then along the ochre-yellow desert valley between the San Andres Mountains and the Sacramento Mountains. The only signs of civilisation in this desolate region were a highway and a railroad line. Finally, we perceived ahead of us a ghostly white sandy plain, White Sands Proving Ground, one of the USAF's best known rocket test sites.

We opened the cabin door . . . and the heat sprang at us like a wild beast. But it was dry—and windy. The Operations Officer met us wearing a sun helmet and provided us with a vehicle to take us the short distance to the mess. After lunch we visited the various sectors of the proving ground, in particular the launching ramps for the *Aerobee* high-altitude research rockets and Colonel Stapp's 10,000-ft. rocket sled (which is to be lengthened to 35,000 ft next spring). We cast a brief glance at the base's bright red target aircraft—remote-controlled converted B-17s—but were frankly grateful when we finally escaped the heat and moved on to our next point of call.

After half an hour's climb we had left this bleak terrain behind us and were flying over the pine-covered peaks of the Sacramento Mountains . . . greater contrast in so small a space can scarcely be imagined! A little later the scenery changed again, giving place to the rocky wastes of Llano Estacado and Edwards Plateau, which stretch as far as San Antonio. It was after dark when we landed.

*

San Antonio and nearby Randolph AFB and Lackland AFB were definitely the hottest places on the whole trip. Here we said goodbye to our Air Force companions and their friendly little aircraft. Our next stage was to Los Angeles aboard an 80-seat coach-class DC-6B (American Airlines), which was full to capacity. In fact we had to wait until three minutes before take-off time before the counter clerk finally decided that the last two passengers officially booked for the flight were definitely not going to show up, and we might have the seats. Two hours' flight took us to El Paso, another 2½ to San Diego and finally, after thirty minutes over the ocean, we landed at Los Angeles International Airport.

More detailed accounts of our visits to the aircraft industry —to Douglas, Lear, Lockheed, North American and Northrop in the Los Angeles area, and to Convair at San Diego—must be reserved for a later issue of *Interavia*. All that need be mentioned here is our trip to Edwards AFB, Air Research & Development Command's flight test center and site of the USAF's Flight Test School, some 100 miles from Los Angeles. A broad, four-to-six-lane highway winds its way through the scrub-covered coastal hills, which gradually become more naked until they are little more than sand dunes. We drove through the "desert cities" of Palmdale and Lancaster with their prefabricated bungalows, resembling houses of cards, passed huge drive-in movie theaters and even caught distant glimpses of cactus trees. A God-forsaken country, though not really a desert. Even the famous Muroc Dry Lake turned out to be an invention. There is not one lake but two: Roseman Dry Lake and Rogers Dry Lake. Edwards AFB lies on the edge of the latter, and its 15,000-ft. concrete runway is extended by another five miles of dry lake bed—a comforting feeling for test pilots faced with technical failures. The hangars and living quarters at the base are painted light green, to provide a little color against the background of glaring yellow sand. The life and activity at Edwards deserve a story to themselves. Some other time perhaps!

Now a few words on the "*City of the Angels*": every guidebook warns against generalizations ("Los Angeles is several different kinds of a place . . ."), but it is really difficult to decide whether this complex mosaic of suburbs, with its population of more than two million, can still be called a *city*. Single-storey bungalows, hotels and palatial homes, gas stations and industrial plants, golf courses and parks, restaurants and drug stores, oil towers and skycrapers in haphazard succession . . . this is Los Angeles. The built-up area is endless—454 square miles, or twice the size of Lake Geneva—and well-known streets, such as Sunset Boulevard or Washington Boulevard, are something like 25 miles long. In this "city" it is impossible to move about on foot, and public transport services are practically non-existent. Taxis, or the cars of business friends, are thus the only means of locomotion.

Against the subtropical climate and other southern influences, especially the "very informal" clothing, the usual American rush strikes the European visitor even more forcibly. Nobody has time, or allows himself time, not even to eat properly! At lunchtime everyone grabs one of the stools at the chromium counter of the nearest diner, swallows his hamburger or hot dog, drinks a glass of ice water, pays at the cash register, and runs off after a few minutes . . . just as far as his car, of course.

Colorado Springs, Colorado: popular high-altitude resort, headquarters of ADC and NORAD, and in future of the Air Academy.

Los Angeles, California: A complicated mosaic of suburbs and broad highways.

San Francisco, California: View of the Golden Gate Bridge from the Top-of-the-Mark.

Seattle, Washington: Boeing Field, on the southern edge of the city, is the B-52's home base. – *Below, view of the Wrigley Building in Chicago, Illinois.*

USAF

New York City: "Old houses with no conveniences . . ." in Lower Manhattan.

New York City: The Empire State Building is 1,472 ft. high including its television mast, and is the world's tallest building.

New York City: Time Square *(top)* and provisional terminal building at New York's Idlewild International Airport *(bottom)*.

One day, as Norman Lynn and I were looking for some lunch, we could find only one parking place. Unfortunately this turned out to be in the "Drive-Inn" part of the restaurant, where "for their convenience" customers eat sitting inside their cars. Waitress No. 4, in snappy gas station uniform, soon appeared with a tray, which she fixed to the car's window-frame. We had to think of something to get out of this situation: "Can we have the car washed and greased while we're eating?"—"Sorry", was the reply, "we don't provide that service!"—We drove away.

*

In San Francisco, some 350 miles further north, the Western European feels considerably more at home.

San Francisco is the most European-looking of America's bigger cities. Built on a series of hills, some of them very steep, with a population of 800,000, the city was the first I had seen for some time with solidly built houses, and streets animated by people—not just cars. It also has an imposing Civic Center, with Opera House, concert hall, City Hall, etc. An exception in the United States, San Francisco supports several live theaters and has such charming museum pieces to offer as the Cable Cars, which climb up and down the hillsides on underground wires. The Top-of-the-Mark Restaurant provides an enchanting view over San Francisco Bay and those two impressive feats of engineering, Golden Gate Bridge and the San Francisco—Oakland Bay Bridge . . . and for a change of scene one can stroll through Chinatown or along Fishermans Wharf.

After this all-too-brief interlude in the "Golden Gate city", I again had to hurry northwards, this time aboard a fully-loaded UAL DC-6B. A brief call at the neighboring city of Oakland and, after an hour and a half's flying, towering Mount Shasta came in view. Hills and valleys were clothed with increasingly dense coniferous forests. We flew over Oregon, home of the spruce once so sought-after by aircraft manufacturers. This timber is still much in demand, and the mighty Columbia River, which forms the border between the States of Oregon and Washington, was alive with floating logs. Soon we were landing at Portland, where a number of Northrop F-89 *Scorpion* all-weather fighters were just taking off on a NORAD patrol flight. Then, after half an hour on the ground, on to Seattle-Tacoma international airport, a brief 30 minutes away.

The port of Seattle, wedged between the waters of Puget Sound (an arm of the Pacific running far inland) and Lake Washington, recalls the cities of northern Europe. Here tall buildings alternate with lower, brick or timbered houses. But here too is the strictly rectangular street pattern characteristic of all American cities. Boeing Field (and King County Airport), on the southern edge of the city was swarming with B-52 super bombers, taking off, landing or merely parked on the perimeter, together with a number of local service civil aircraft—mostly C-46s and DC-3s. But, again, the story of my visit to the Boeing plants at Seattle and Renton must be left till a later date.

*

The next stage of the journey, the 1,750-mile flight from Seattle to Chicago, with a long detour to the north because of bad weather, was made non-stop in a UAL DC-7. Actual flying time was only five hours, but we "lost" three hours en route, so that the trip took virtually eight hours, or ten including travel time to and from the airports. The whole flight took place above a thick cloud layer, and the only distraction was a good lunch.

Chicago, population 3,600,000, is the second largest city in the United States and spreads nearly 30 miles along the shores of Lake Michigan. Only 120 years old (city rights were granted in 1837), it seems to have the deep-rooted ambition to outdo New York in superlatives. Chicago is proud of its skyscrapers on the Loop, the sunless city heart fenced in by the curving elevated railway, where during the working day half a million people are packed into only 35 blocks. The city boasts the world's biggest office block (Merchandise Mart, where 26,000 persons are employed), as well as the tallest garages (twelve storeys), the broadest highways, the biggest stockyards, the largest ganster quarters (Al Capone's Gorillas once occupied a whole neighbourhood, today inhabited by more civilized families), and finally the world's busiest airport, *Midway*, with roughly 400,000 aircraft movements per year.

It was at this airport that I was to make acquaintance with the shady side of air travel in bad weather. Up at 5 o'clock in the morning, I arrived at the airport shortly before 7, after a 40-minute bus ride, for a flight to South Bend, where I was to visit *Bendix Products Division*. The airport was thick with fog, with visibility varying between 1,000 and 2,000 ft. At 7:15 the passengers were loaded into the aircraft, at 8:02 the engines were started up... and there we sat for 110 whole minutes waiting for permission to take off. In front of us seven other transports were waiting equally patiently, with engines running, and behind us were another thirteen. Naturally the aircraft coming in were brought down first. Arriving nearly three hours late at my destination, I regretted—for the first time—not having gone by train.

Chicago served as headquarters for visits to *Collins Radio Company*, at Cedar Rapids, Iowa (200 miles or 2 flying hours away) and the *Allison Division* of General Motors (one hour's flight). With its typically Middle West, widely spaced wooden houses and its broad stretches of green, Cedar Rapids is like a country suburb, while Indianopolis, home of the Allison Division, is a full-sized city of almost European aspect.

The last major stage in my American tour took me via Cincinnati to New York, where "Bud" Soden was awaiting me with a heavy program of visits to manufacturers in New York City and three neighboring States: *Pratt & Whitney* at East Hartford, Conn., *Hamilton Standard* at Windsor Locks, Conn., *Sikorsky Aircraft* and *Lycoming* at Stratford, Conn., *General Precision* at Pleasantville, N.Y., *Aircraft Radio Corporation* at Boonton, N. J., *Federal Telecommunications Laboratories* at Nutley N.J., *Fairchild* (Engine Division) at Deer Park, L.I., Republic at Farmingdale, L.I., finally *Vertol* at Morton, near Philadelphia, Pa. and *Sylvania* in New York City. Many pages could be written on each of these visits, particularly on details of American production methods... and this will be done in the near future.

In New York City I was welcomed by an old acquaintance, the heat. Unfortunately not all offices are air-conditioned, at any rate not in the skyscrapers of Lower Manhattan. "We're moving out", the export manager of a steel company told me as we wiped the beads of sweat from our brows, "these old houses have no conveniences." I learned that the electric wiring in these skyscrapers will not carry air conditioners, but just the same... "old" houses 30 to 50 storeys high!

The taxi driver who took us back to more modern midtown wasn't too happy either. "Look at it," he grumbled, "you can't get through... as far as I'm concerned, you can take the whole of Broadway back to Europe with you... as a free gift! And this is nothing to a crosstown trip at noon. Takes a full hour from the Hudson to the East River, sir. You can walk it in half the time."

*

A final look around from the observation platform on the Empire State Building's 86th storey on to the pulsing life of the metropolis, the neighboring skyscrapers and the lively shipping along the waterfront. An hour's drive—first through the broad Midtown-Queens Tunnel under the East River and then along the dead-straight Expressways—took me to New York International Airport. Without any kind of police or customs formalities—how different from my arrival here—I went straight on board the DC-7C, whose engines began to turn on the dot of 4 p.m. Several miles of taxying along the "duty" runway and a rapid take-off followed. Above Nova Scotia we were served a first-class supper. By 1:30 a.m. (New York time) it was daylight, and three hours later Swissair's *Seven Seas* touched down at Cologne's rain-washed airport.

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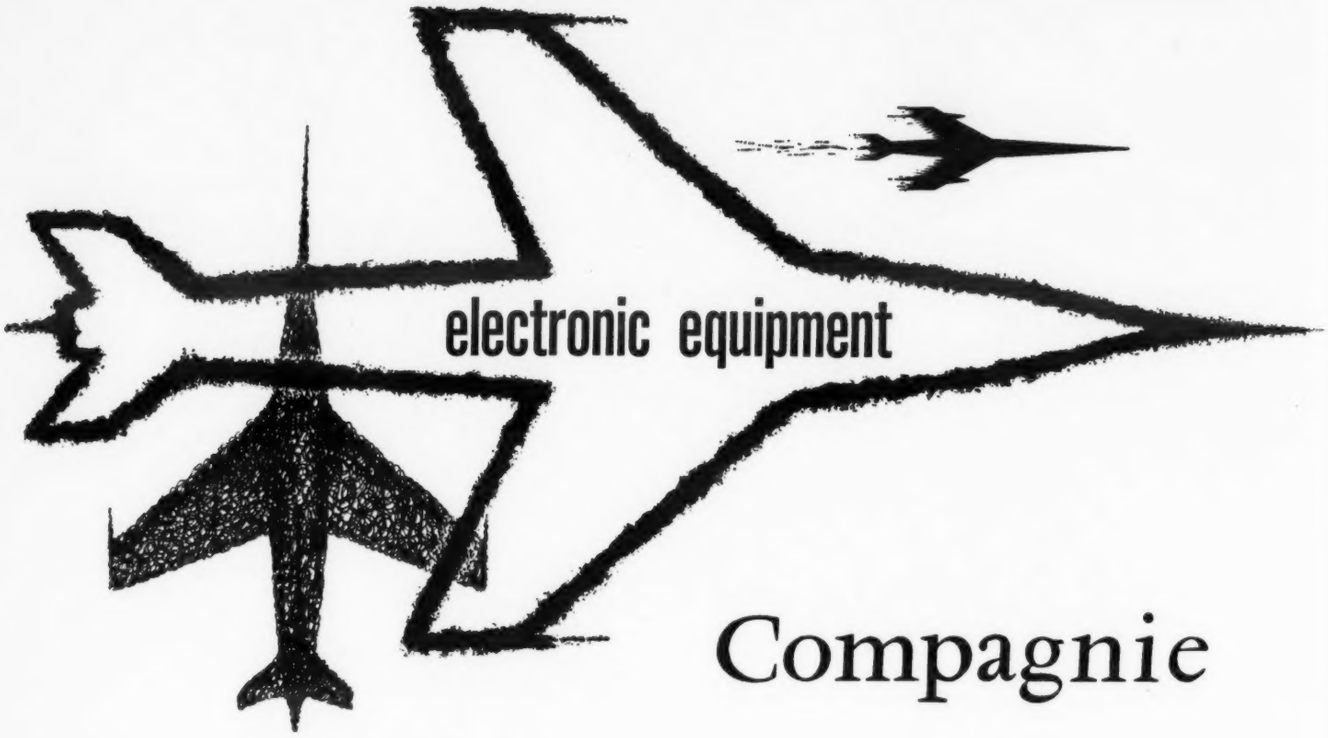

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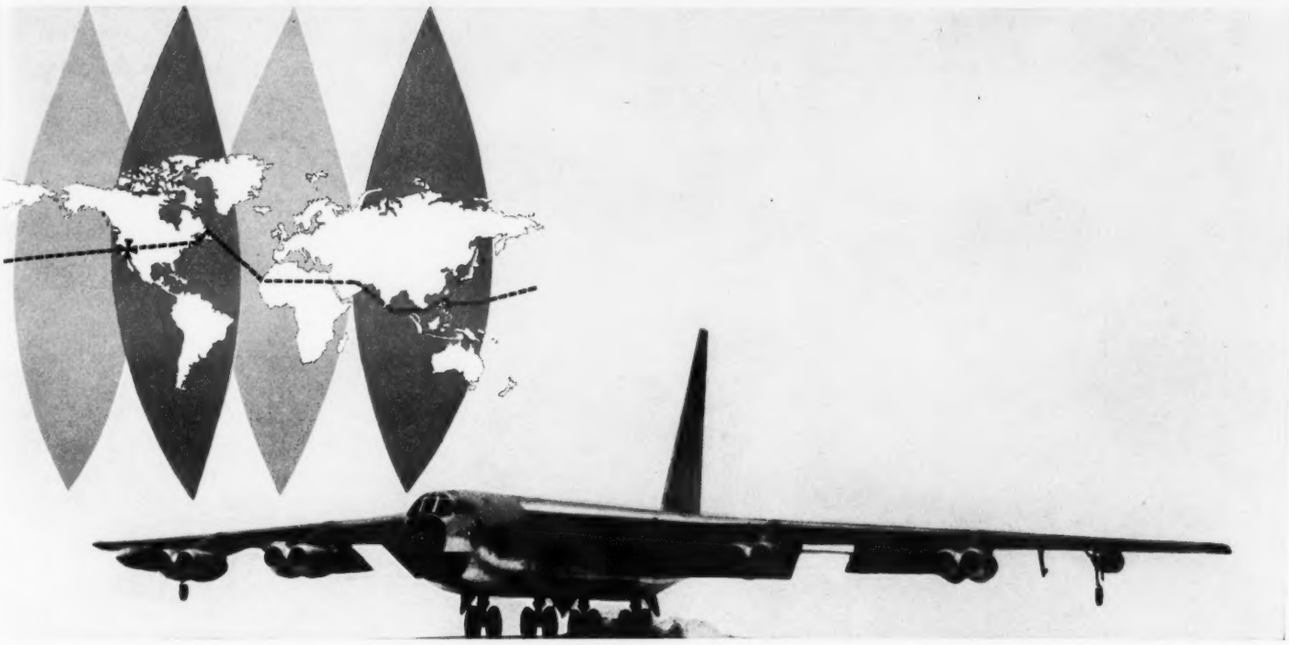

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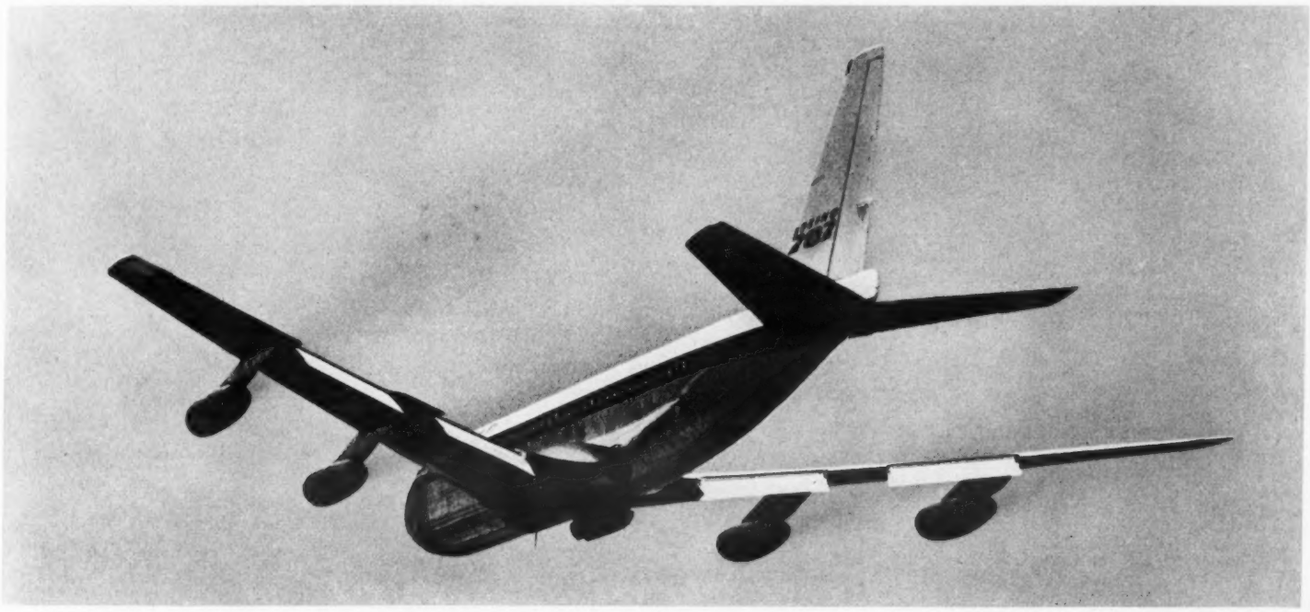

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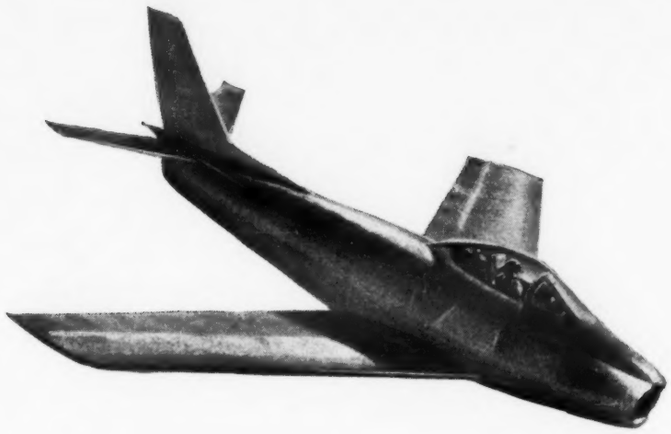

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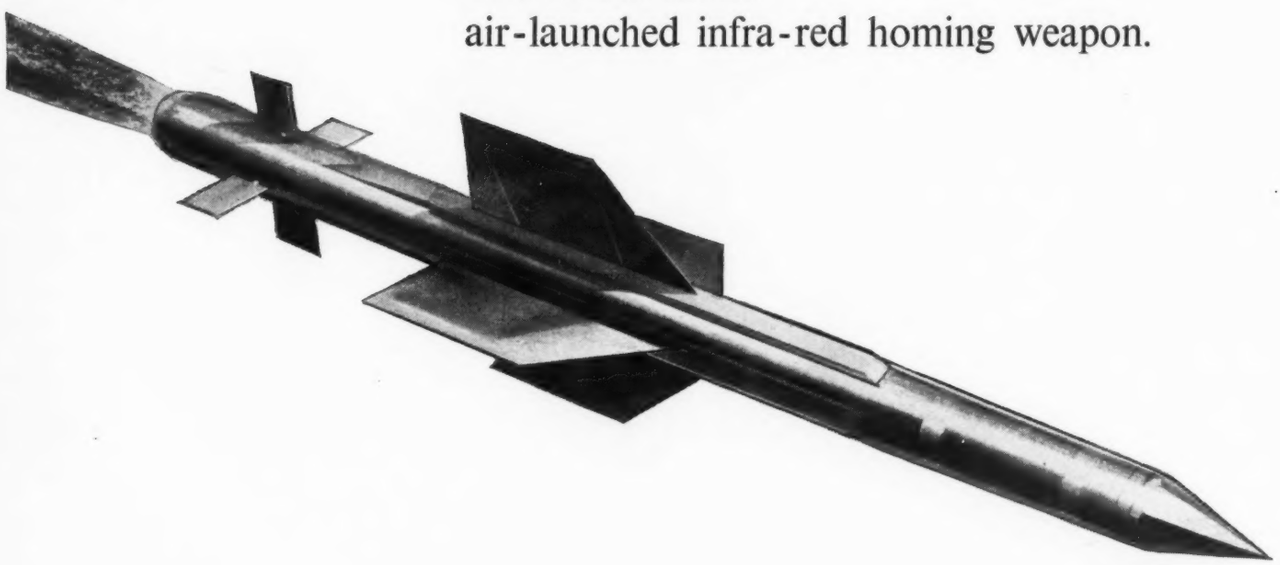

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Some Problems of the Future

New tasks facing the USAF's Air Research and Development Command*

by Lt. Colonel Carlo R. Tosti,
Chief, Office of Information Services, ARDC

The final article in the series on the United States Air Force has been reserved for the organization to whom falls the responsibility of ensuring the future of America's air power and thus of her military position in the world, namely Air Research and Development Command. " Ad inexplorata *", the motto of Edwards AFB flight test center, describes the activity of the whole Command, which has its headquarters in Baltimore, Maryland, and operates branch organizations in Los Angeles, California, and Brussels, Belgium, as well as ten research and development centers throughout the United States, employing nearly 40,000 military and civilian personnel.*

Commander of ARDC is Lieutenant General Samuel E. Anderson, *who took over control of USAF research from General Thomas S. Power (today Commander-in-Chief, Strategic Air Command) in the summer of 1957. He is assisted by a Vice Commander, two special assistants and three Deputy Commanders, plus the heads of two dozen directorates and the commanders of the ten test centers. What ARDC plans to undertake during the years to come in fulfilment of its mission—to seek new basic knowledge from which improved aeronautical equipment and techniques, material and weapons can be developed—can best be seen from the following statements by a qualified spokesman, Lieutenant Colonel Tosti, of the Office of Information Services.*

Editors.

Fifty years of progress—but what of the future? Where do we go from here?

The product of our technology over the past fifty years has brought us to the ballistic missile development program. The Air Force ballistic missile program includes the development of two Intercontinental Ballistic Missiles (ICBM)—the Convair *Atlas* and the Martin *Titan*—and an Intermediate Range Ballistic Missile (IRBM)—the Douglas *Thor*. Our interest in this area is not a new one.

Our thinking and activity in this type of development, however, goes back to 1946 with project MX774. The MX774 vehicle, which underwent a successful testing program, proved the feasibility of such interesting innovations as swiveling rockets for flight control.

Impetus was given to the program by the thermonuclear breakthrough in 1954. This breakthrough gave us the capability of producing a small but devastating warhead, thus allowing less stringent accuracy requirements for the missile system.

The past three years have seen a research and development program of unprecedented magnitude. From two major contractors—for airframe and engine—it has spread across the country with prime contractors for alternate airframes, engines, guidance systems and nose cones. When one adds to this picture the many governmental agencies and Air Force research, development and test centers, and further superimposes the large number of sub-contractors engaged in this program, the size of this program is readily apparent. Roughly, a half billion dollars has been invested in new test installations and plant expansion alone—a substantial share of this being privately financed. At Convair in San Diego a vast plant area was created virtually overnight for production of *Atlas* airframes and, within one year, pasture land at nearby Sycamore Canyon was converted to a complex for captive testing of the *Atlas*.

Similar expansion has taken place in the engine development program at North American's Rocketdyne facility near Los Angeles and the Aerojet General Corporation which expanded its complex of facilities at Sacramento, California, to develop and produce engines for the *Titan* ICBM. And so it goes with General Electric, AVCO, Lockheed, Burroughs, Bell Telephone Lab, Remington Rand, MIT, A.C. Spark Plug, Arma and others.

These few examples make it clear that the Air Force ballistic missile program represents a concerted effort of unprecedented magnitude being jointly pursued by the most competent and widespread government, science and industry team ever assembled on a single project.

Out of this tremendous effort will come a wealth of design information and components that will be useful for other things beyond those for which they were designed. The airframe, propulsion, and guidance sub-systems developments and the data which will become available as ballistic missile test flights are made, will make possible a whole gamut of follow-on projects.

The flow of important design data has already begun with the Lockheed vehicle, the X-17. The X-17 re-entry tests, and other Hypersonic Test Vehicles have provided valuable research data on heating and other problems that will be encountered when a warhead or airframe re-enters the earth's atmosphere at hypersonic speeds.

*

While the ballistic missile program is providing an invaluable impetus to the exploitation of flight technology, the expansion of our operational performance parameters for both manned and unmanned flight requires an orderly approach to the acquisition of basic or fundamental knowledge in many areas of research. Some of the problems which face us are apparent when we consider the flight limitations which delineate a narrow corridor for the extension of future flight performance *(Fig. 1)*.

On one side, we are restricted by an area of "*Too Hot*". An area in which we are traveling too fast and too low. Because of aerodynamic heating, skin temperatures of 2,000°F or greater will be generated—temperatures which cannot be sustained for prolonged periods of time with our present structural materials. On the other side of the corridor is that area which is "*Too Slow*" for sustained horizontal flight.

To obtain such research data on materials and aerodynamics design, we must have research tools. One of these research tools is the "*Hotshot Tunnel*" *(Fig. 2)*. The operating principle of Tunnel Hotshot is basically simple, but it has involved some unique design and fabrication problems because of the extremely high pressures and temperatures generated during the brief test run.

The two main parts of the tunnel are an arc chamber and the downstream portion of the tunnel which contains the test section, where the model is mounted. A thin plastic disc separates the arc chamber from the test section of the tunnel. Air is pumped into the arc chamber creating very high pressure. Conversely, the downstream

Fig. 1: Flight limitations (abscissa) plotted against altitude. Photo shows two "closed areas", labelled "too hot" (below) and "too slow" (above), also the position of the Bell X-2 high-altitude research aircraft.

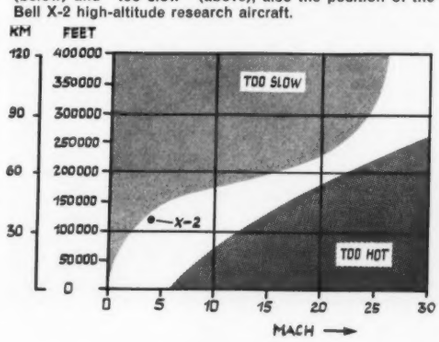
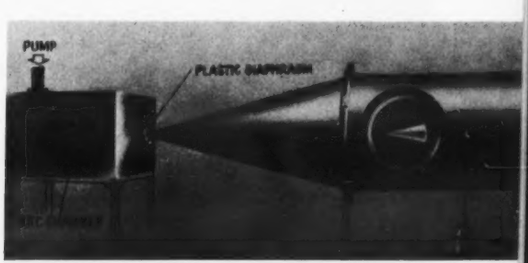


Fig. 2: Diagram of the Hotshot Tunnel, in which flow speeds of 11,000 m.p.h. and temperatures of 15,000°F have been obtained . . . but only for fractions of a second.



* Extracts from a paper read by Lieutenant Colonel Tosti at the Air Force Association Convention in Washington, D.C., on July 31st, 1957. In addition to the questions discussed here the paper also dealt with ceramic materials, auxiliary sources of power for space vehicles, e.g., atomic reactors and solar batteries, study of the aurora and geomagnetic storms, and the protection of crews at high altitudes and under extreme accelerations.

section is pumped down to an air pressure as low as approximately a millionth of an atmosphere. A powerful electric explosion breaks through the plastic seal and flows through to the test section, for a usable test run lasting but a fraction of a second.

The effects of tunnel tests on scale models of missile nose cones of various shapes and materials will assist in determining the best possible nose configuration and material for hypersonic missiles. More than 100 successful test runs have already been made with this new equipment which represents a substantial improvement over devices previously used for this type of testing. Even so, total test time for all runs is less than a quarter-minute.

To provide us with a tool of longer endurance we have under development with the Cornell Aeronautical Laboratory, a facility designed to provide an airflow of 10,000 miles per hour and temperatures of 9,000°F for periods sustained to fifteen seconds or more. Popularly referred to as "*Big Rollo*", the device is a unique arrangement of shock tubes capable of producing the continuous flow of high-speed, high-temperature air. It is able to operate at temperatures well beyond the melting-point of all known materials.

Another tool that we need in our materials research is one which will give us very high temperatures. For prolonged periods of time, the sun itself can be put to work through the "Solar Furnace" *(Fig. 3)*. With this test facility the sun's rays are focused on a test section by a large parabolic reflector. With this harnessing of sunheat we will be able to concentrate temperatures of 8,000°F on the test section for long periods—governed only by the appearances of the sun itself. Furthermore, it will produce pure uncontaminated heat; that is, heat generated without the detrimental by-products of combustion or electrical charges. Although quite a valuable tool, this is an expensive facility, construction of which has just been undertaken (by ARDC's Air Force Missile Development Center near Holloman AFB).

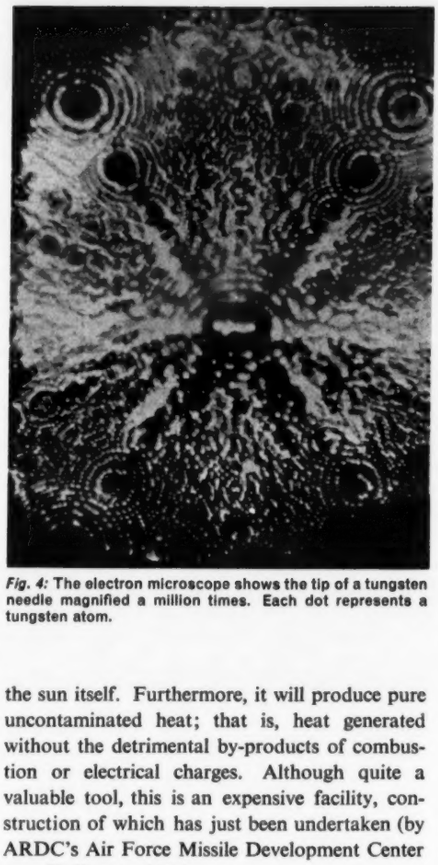


Fig. 4: The electron microscope shows the tip of a tungsten needle magnified a million times. Each dot represents a tungsten atom.

Another valuable tool in learning about materials is the "Ion Field Emission Microscope"—or electron microscope. With this instrument we can actually look at atoms—once considered invisible *(Fig. 4)*.

Fig. 3: Model of the ARDC solar furnace being built by the Air Force Missile Development Center in the Sacramento Mountains, New Mexico. Behind, Dr. Paul D. Jose (right) and Dr. Know Millsaps, the two responsible scientists.

*

Let us go back now to the limitations of flight we mentioned earlier *(Fig. 1)*. Besides the limitation of heat there is the area of performance in which we are travelling too slow for the altitude at which we are flying. What can we do to roll back the curtain here ?

You might well ask what happens to air at these very high speeds, temperatures and altitudes. We suspect that air is no longer air, as we know it, either at extremely high temperatures or altitudes. At high speeds for instance, we find that the theoretical basis for much of our aircraft and missile design no longer holds. We haven't the means of predicting how craft will behave or how they should be designed for these speeds. To get answers in the transonic and supersonic area, the wind tunnel is an important tool.

An effective tool in wind tunnel studies is the "*Color Schlieren Optical System*" in wide use by the Air Force and the National Advisory Committee for Aeronautics. A Schlieren Optical System shows the shock wave patterns produced by aircraft and missile shapes in wind tunnel tests at transonic and supersonic speeds. Color Schlieren systems make use of the fact that every color has a different wave length. Each bends at a slightly different angle when passing through a transparent medium such as a prism—or the variable density in a shock wave cone. Green, near the center of the spectrum, is generally selected as the background color. Strongest *compression* is red, and the strongest *expansion* appears blue.

We must also learn more about the characteristics of air itself. What happens to air as it gets hotter ? It changes from its normal condition as stable molecules and as it goes through higher energy states the molecules break down into atoms, and finally the atoms into ions, or charged particles. In the research program, a great deal of theoretical analysis and experimentation is being applied to understand these changes and their effects.

In addition to the charged particles, or ions, which are obtained at high Mach number, there are also charged particles in the upper atmosphere. Can we put these ions to work ? Can we use the charge of these particles for lift or for thrust ?

This has led to the expansion of an area of scientific study known as *magneto-hydrodynamics*. Can an electrically charged wing or aerodynamic body passing through a sea of ions attract these charged particles on the one side and repel them on the other to produce lift ? This possibility is one that deserves further study *(Fig. 5)*.

Another possibility is the use of ions for propulsion, particularly for vehicles operating beyond the heavy air layer at lower altitudes. Many scientists believe an ion rocket engine can be developed with present know-how requiring no scientific breakthrough *(Fig. 6)*. The fuel for an ion rocket might be an alkali metal such as cesium or rubidium which yield large quan-

tities of ions when vaporised and brought into contact with a hot platinum or tungsten surface. The ions would then be harnessed in a stream and accelerated by a magnetic field to produce thrust.

*

While the concept of an ion rocket is an interesting possibility for advanced phases of high altitude flight, we are still dependent upon the chemical type of rocket, as developed in conjunction with our Ballistic Missile Program, to blast off from earth. Over the coming decade, there is promise that the efficiency of chemical rockets may be increased significantly. If this is accomplished, the size of the missile could be appreciably reduced.

One approach to the development of fuels of higher specific impulse is in the area of *free radical chemistry*. Free radicals, as ultra-energy fuels, have theoretical specific impulse values ranging from 400 to 1,200 as compared to the average value of 250 for present-day fuels, or in other words, have from about two to five times the "oomph" or "kick" of present-day rocket fuels. With free radicals, the energy of recombination, rather than the energy of combustion as in hydrocarbon and boron fuels, supplies the heat output *(Fig. 7)*.

Free atoms and radicals can be produced by thermal, chemical, photo-chemical, electrical, and nuclear processes. The use of free radicals offers a real possibility of extending performance of rockets by an order of magnitude greater than any other foreseeable means.

An interesting fact is that, essentially, free radicals exist in the high atmosphere. You may have noticed that at night there is always *some* light in the sky. It had been suspected that the sun's energy could break down oxygen into its atoms and the energy thus acquired by these atoms could be released under proper conditions.

To confirm our theory by carrying out experiments in the high atmosphere, a rocket was loaded with a chemical believed to be deficient in the upper atmosphere. The chemical was released above 200,000 feet. In this case, the small quantity of gas we sent up released enough

Fig. 5: Diagram of magnetodynamic lift on a wing moving through an ionized air layer.

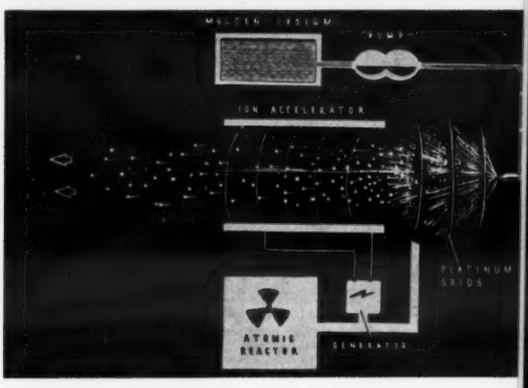


Fig. 6: Diagram of an ion rocket engine, which vaporizes, ionizes and electrically accelerates molten cesium in the combustion chamber.

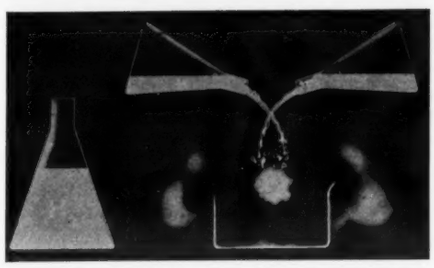


Fig. 7: Atomic hydrogen (H), which can be obtained from molecular hydrogen (H_2) by thermal, chemical or other processes, releases vast amounts of energy on recombining to the molecular form.

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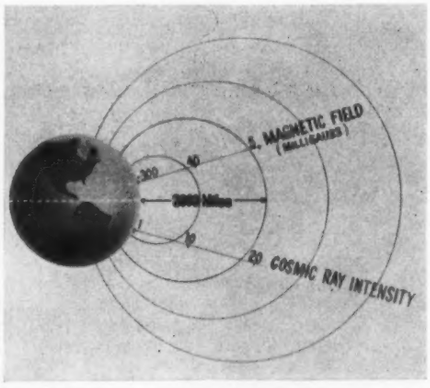
8. Air Force Armament Center, Eglin AFB, Florida;
9. Air Force Special Weapons Center, Kirtland AFB, New Mexico;
10. Air Force Personnel and Training Research Center, Lackland AFB, Texas.

Fig. 9: Colonel John P. Stapp, chief of the Aero-Medical Field Laboratory at Holloman AFB, with a model of the rocket sled on which he made his sensational acceleration and braking runs and reached a speed of 632 m.p.h. in December 1954.

Fig. 8: Artificial earth satellites will open new prospects for research, including the investigation of the earth's magnetic field and cosmic radiation.



energy to visually glow twice as bright as Venus, the brightest star, and half as bright as the Moon. Thus we have confirmed that there is stored energy at these altitudes which can be released and which may possibly be put to use for propulsion.

Another approach in the area of propulsion development is the use of nuclear energy. We have heard of the fission process applied to the submarine *Nautilus*. In the Air Force, we have had underway for several years a program for the development of atomic engines for nuclear-powered aircraft.

*

How much data do we have on the atmosphere today ?

Beyond 200,000 feet we know very little and have very little data on the characteristics of temperature, pressure, density, and wind. There are, however, several tools which can be used to get these answers. At the low altitudes, of course, we have the balloons with which we can get information with respect to the temperature, pressure, density, and winds. We can use sound techniques, also, and light-beam, and radio and radar techniques to conduct upper air investigations.

One of our best tools, of course, particularly at the higher altitudes, is the research rocket. However, with all the rocket flights that have taken place in the past decade, we still have relatively little data because of the short duration of these flights.

The International Geophysical Year with the launching of such vehicles as the satellite opens a new era in which we visualise research tools which will be flying at altitudes of several hundred miles for prolonged periods of time. These will be invaluable research tools in learning more about this essentially unexplored region.

As we look to the future, we must learn more about the effects of geomagnetic storms, of the ionized layers of the atmosphere, of the aurora, and meteors on Air Force operations. We must be able to predict operationally important variations in these parameters, and we must, if possible, use these phenomena to our own advantage.

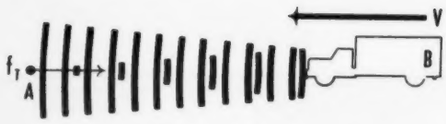


Fig. 1

DOPPLER-NAVIGATION

By William J. Tull,
General Precision Laboratory, Pleasantville, N. Y.*

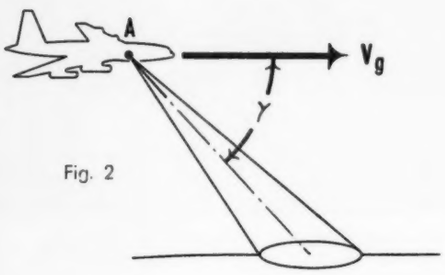


Fig. 2

Since December 17th, 1903, when man first flew, those who have been actively associated with aviation have, at one time or another, been concerned with the problem of how to determine ground speed and drift angle of an aircraft, without aid from the ground. But only in recent years has it become possible to do this with a high degree of accuracy, in all kinds of weather, and with equipment of practical size and weight.

*

The technique, which makes possible the sensing and measurement of ground speed and drift angle, utilizes the "Doppler effect" at microwave frequencies, and can be illustrated as follows: *Fig. 1* shows a stationary transmitter-receiver *A*, emitting a signal at a frequency f_t; the signal is reflected from a truck *B* back to the receiver *A'*; when the target truck *B* approaches the transmitter *A* with a velocity of *V*, there is a Doppler shift in the frequency of the reflected signal, from f_t to:

$$\Delta f = \frac{2V}{c} \cdot f_t$$

where *c* is the velocity of propagation of the electromagnetic signal.

Fig. 2 shows the transmitter-receiver *A* now located in an aircraft in flight, sending out a beam of energy from the aircraft to the ground. The beam is transmitted at an angle γ from the direction of the aircraft velocity vector, V_g. In this case the equation is:

$$\Delta f = \frac{2V_g}{c} \cdot f_t \cdot \cos \gamma$$

and it is evident from this equation that Δf is a measure of the velocity V_g, since the other quantities are known. It will be noticed that, in the above equation, all energy reflected or back-scattered from the ground at angle γ undergoes the same Doppler frequency shift, Δf. Assuming a plane earth, the intersections with the ground of families of beams having constant γ angles are hyperbolæ, which are conveniently thought of as contours of equal Doppler frequency shift. Consider *Fig. 3* as an observer directly above the airborne transmitter *A* which is travelling in the direction V_g; in the center the constant frequency contour for a γ angle of 90° is a zero Doppler frequency contour as there is no relative velocity between the transmitter *A* and the ground. i. e. $\Delta f = 0$.

If a small pencil beam is projected from transmitter *A* to the ground at *B*, then the energy is essentially confined inside the ellipse at *B*; within this ellipse, signals scattered from the ground nearest the transmitter are characterized by a larger gamma angle and a lower Doppler frequency shift than those from further out (see spectral power density plot *Fig. 3*).

Fig. 4 again plots the same constant frequency hyperbolæ, but in this case two beams of energy are transmitted in different directions. Examination shows that one beam is confined to the region *L* and the corresponding return signal has a spectrum as shown by the diagram; the spectrum for region *R* can be similarly pictured. If the angle θ between the *L* and *R* regions is maintained constant while the whole beam-forming assembly is rotated about a vertical axis, then the frequencies associated with beams *L* and *R* will change accordingly. *Fig. 5* shows the situation when the beam assembly has been

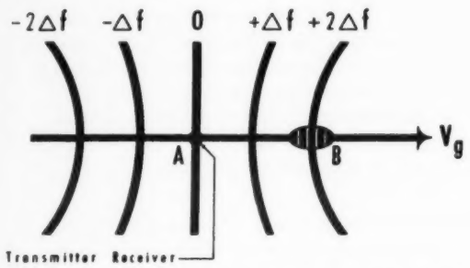
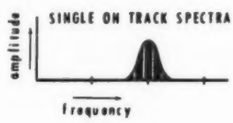


Fig. 3



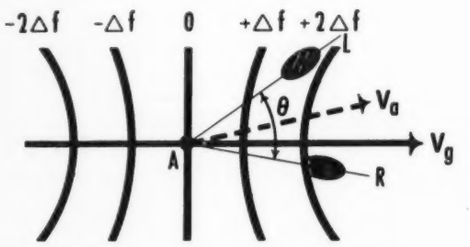


Fig. 4

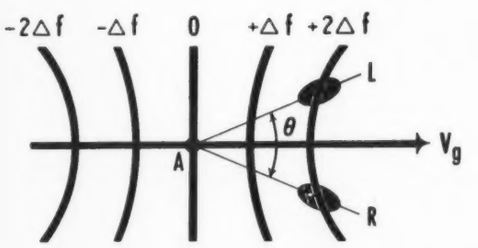
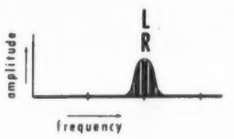
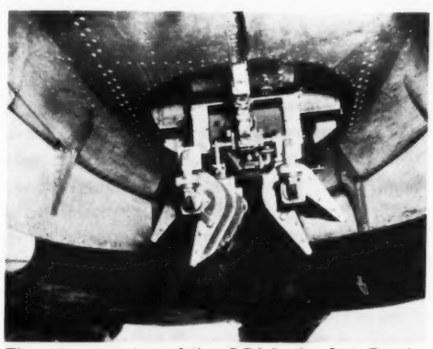


Fig. 5

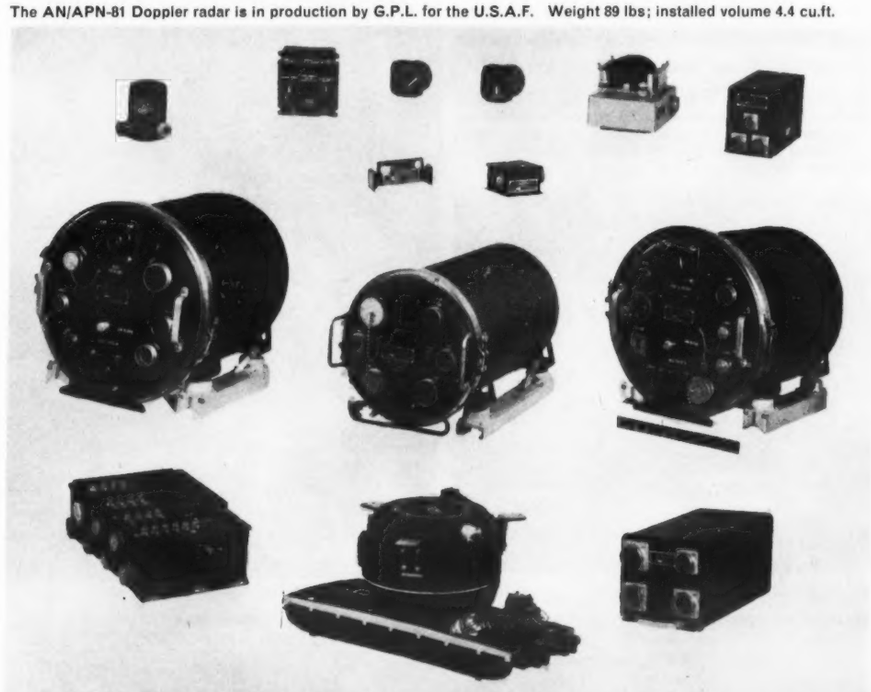


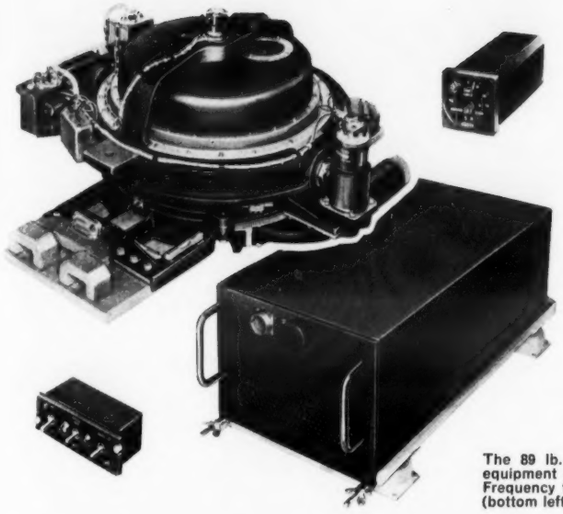


The antenna system of the G.P.L.3, the first Doppler navigation system developed by General Precision Laboratory.

* Presented at the 25th Annual Meeting of the Institute of the Aeronautical Sciences in New York in January 1957.

The AN/APN-81 Doppler radar is in production by G.P.L. for the U.S.A.F. Weight 89 lbs; installed volume 4.4 cu.ft.





The 89 lb. General Precision Laboratory *Radan* Doppler navigation equipment comprises: Antenna-Transmitter-Receiver Unit (top left); Frequency tracker (bottom right); indicator (top right); control panel (bottom left).

The AN/APN-95 computer produces ground, air and wind speeds on the speed dial, together with true heading, drift angle, magnetic variation, true ground track transverse track, course to destination and wind direction on the direction dial.

rotated until the frequencies from L and R are equal and, in this case, the bisector of angle θ lies in the direction of the velocity vector, V_g.

Characteristics of General Precision Laboratory's RADAN Model PC-201 airborne navigation equipment for commercial aircraft.

- Speed Limits: 70 to 1,000 knots with a less than 1% error.
- Drift Limits: 35° maximum, left or right, with a less than 0.5% error.
- Altitude Limits: less than 200 feet to 70,000 plus feet.
- Attitude: nominally level flight.
- Power: AC: 400 watts, 380-420 cps, 115 V.
  DC: 20 watts, 28 V.
- Cooling Air: approximately 3 lbs./minute.
- Total weight: 89 lbs.
- Total installed volume: 4.4 cubic feet.

Briefly then, by measurement of frequency Δf it is possible to determine the ground speed of an aircraft, and by servoing a two-beam antenna system until equal Doppler frequencies are received from each, it is possible to measure drift angle. It is also possible to determine drift angle with a fixed two beam system by measuring Doppler frequency shift associated with each antenna beam; in this case the drift-angle must be calculated from the data rather than coming directly from a null measurement.

Thus far the discussion has been limited to the basic sensing of an autonavigator system, the Doppler Radar drift angle and ground speed measurement equipment. It is apparent that these measurements can be combined with heading information to provide continuous dead reckoning, thus presenting a continuous display of position in any desired coordinate system. Interconnection of Doppler radar with a computer will provide latitude and longitude of present position, and course and distance to each of several desired destinations, or ground speed, air speed and wind speed etc. Certain computers also have " Present Position Storage " features, permitting present position counters to be stopped for reading or setting, and automatically storing aircraft travel while thus stopped.

*

In conclusion it will be noted that Doppler navigational equipment, in military use for some time, is now in production for civil use and provides the air transport companies with an exceptionally accurate system of particular value on intercontinental long-range routes.

A New Helicopter Simulator by Short

Helicopter pilot training, either primary, advanced or conversion, is more expensive and requires a longer period than fixed wing training; if only for these considerations, both civil helicopter users and the Services will welcome the production of a universally applicable flight simulator now in an advanced stage of development by Short Brothers & Harland's research department.

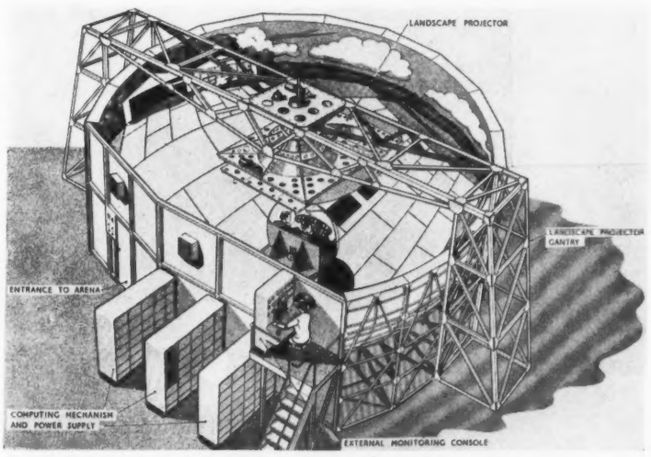
The Short equipment will simulate not only most of the physical and visual sensations and routine noises of helicopter flight, but will also reproduce the particular characteristics of any given type, incorporating varying weather conditions and the introduction of emergencies such as complete or partial failure of the engine and other components. Designed mainly for pilot training in the primary and advanced aspects of helicopter flying, the simulator will also be suitable for conversion between types, and for research into control and stability.

The central feature of the equipment (see illustration) is a full-size cockpit, with full controls and instruments, forming part of an abbreviated fuselage, supported on a universal mounting. Cockpit movements of $\pm 30°$ about two axes is controlled by electro-hydraulic servo-mechanisms providing attitudes as directed by the computing system in response to the pilot's controls. The angular movements of the fuselage present pitch and bank attitudes, but yawing motions are presented by appropriate changes in a composite colour horizon and landscape image thrown by two projectors on to the curved screen surrounding the cabin. This image gives the pilot the impression of being surrounded by a landscape, stretching to the horizon which always remains above eye-level; changes in height produce an appropriate change in the scale of the landscape.

The two image projectors are linked in their yawing motions and are controlled through the computer system in answer to the pilot's controls. The horizon projector is situated below the cabin and presents the sky above the horizon line and the land or sea below; the landscape projector is mounted above the cabin and presents a landscape, including three-dimensional objects such as buildings and trees, blending into the horizon image. During all motions the perspective views of the three-dimensional objects change to present a realistic impression of relative movement.

The computer system is a network of electronic and electro-mechanical units which are interconnected so as to solve by analogy the various simultaneous equations of motion which represent the behaviour of the helicopter. In the main the computing channels consist of integrating and adding units together with a number of multiplier units for product formation, function generators to represent non-linear characteristics, and resolvers for trigonometrical operations. The pilot's controls are coupled with potentiometers feeding the computer which commands the projector and cabin servos and also the simulated instruments in the cockpit. The computer is provided with subsidiary loops to represent the effects of variation of air density, pressure with altitude and induced flow. Noise generating circuits monitored by the engine and rotor speed computing servos synthesise the sound and vibration of rotor and engine.

Selectional view of the Short Helicopter Simulator



Equipment Round-Up

● **Lear Incorporated** has been engaged in development and design of inlet control systems since the spring of 1954 and is currently producing inlet geometry variation equipment for three supersonic fighters. Within this production programme, the company also supplies all the required accessories, such as hydraulic power units, screwjacks, computers, etc.—One of these inlet systems is shown in diagram form in *Fig. A*: the inlet section is varied by shifting the translating ramp (here shaded and marked " plug ") in the direction of the flow, while the flow pressure in the duct is regulated by means of bleed doors. This is the system used in the Republic F-105 supersonic fighter. It offers the advantage that the external configuration of the inlet, in particular of the inlet lip, is not altered by displacement of the plug, a fact which greatly helps to achieve minimum shock drag in the supersonic range. The central control instrument for both plug and bleed doors is a Lear Model 1314A computer (see *Fig. C*) which evaluates incoming signals and initiates any required control processes.

A second Lear inlet system is shown in *Fig. B*. Here inlet section and inclination, together with position of the inlet shock waves are varied by means of a plug which is displaced at right angles to the flow. The plug in turn is automatically regulated by a computer via a control mechanism. This system also has the advantage that no change is made in the external configuration of the inlet.

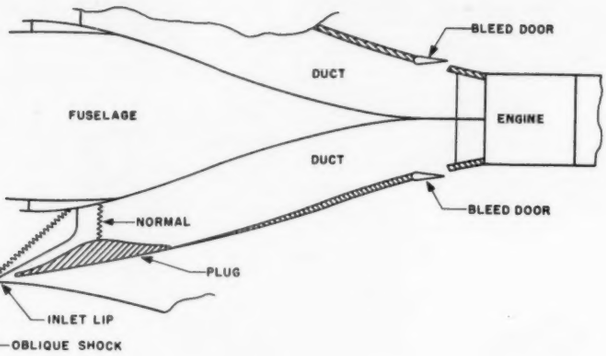


Figure A

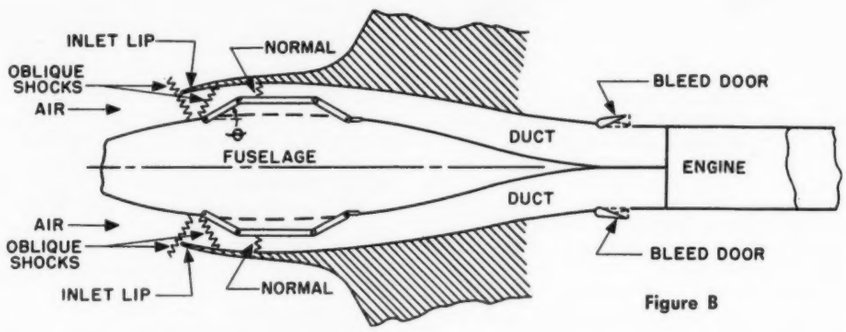


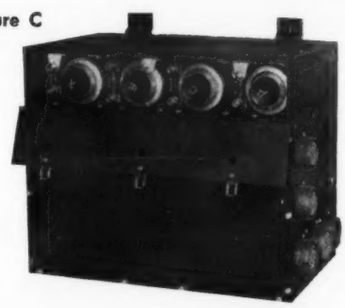
Figure B

● **Etudes et Techniques Nouvelles,** Paris: Electronically controlled vibration table for testing the vibration resistance of materials or components in the 100 to 500 c/s frequency range. The plate has a diameter of 12 ins. and carries three T-grooves for securing the test specimen. The following accelerations can be obtained:

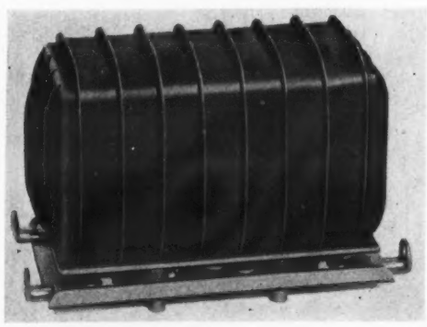
Frequency in c/s	Acceleration in g
500	1 to 30
400	1 to 20
300	1 to 15
200	0.5 to 11
150	0.5 to 8
100	0.5 to 6

The vibration table meets the French AIR 0850 standards; it is extremely robust in structure, simple to maintain and has absolute stability during lengthy test runs, and low power consumption.

Figure C



● **Aircraft Radio Corporation :** DV-10A DYNAVERTER fully transistorized power converter for transforming low-voltage d.c. to high-voltage d.c.—Input: 27.5 volts d.c.; 2.3 amps (for 200 ma output). Output: 275 volts d.c.; 200 ma maximum continuous at 55°C; 100 ma maximum continuous at 71°C; 200 ma intermittent at 71°C.—Regulation: less than 5% at maximum rated output. Efficiency: 85%. Ripple: 0.3%. Temperature range: —55°C to +71°C (operating): —55°C to +90°C (storage). Temperature rise: 10°C at maximum rated output. Weight: 1.7 lb. Size; $2^{7}/_{8} \times 3^{1}/_{4} \times 4^{3}/_{4}$ ins.



● **General Precision Laboratory Inc.,** Pleasantville, New York, announces that its closed-circuit airborne television system, now in use by the military and by manufacturers of aviation equipment, may soon be installed also on commercial airliners. In a recent demonstration General Precision used two cameras, which are not only designed for operation under high vibration conditions, but are also equipped with remote iris and focus control to meet changing conditions, such as an abrupt passage of the aircraft from an overcast into a brilliant sunshine area. Together the two cameras provided views of the ground, the surrounding airspace, the engines, undercarriage, wings and tail assembly; display was on a monitor set in the cabin. Each camera weighs only 42 lbs.

● **The Instrument Department of General Electric,** West Lynn, Mass., is marketing a low-cost electrically operated compass system for sports and business aircraft. Sales agent is the Wilcox Electric Co. Inc., Kansas City, Mo. The system, which weighs only 8 lbs., operates reliably up to altitudes of 40,000 ft. Accuracy ± 2°; power required 24 Watts (115 Volts, 400 c/s, three phase).

● **Armour Research Foundation,** Illinois Institute of Technology, has developed the " Vortex Thermometer " under contract to ARDC's Wright Air Development Center. It will give pilots direct, true, free air temperature readings, accurate to ± 1° F. The thermometer can assist in locating jet streams and the position of max. velocity in them by giving immediate readings on temperature changes, and thus can help increase an aircraft's range or save fuel.

● **Aluminium Company of America,** Pittsburgh, Pennsylvania, has announced a new aluminium alloy, designated X-2020, which combines aluminium and lithium and retains its properties at temperatures up to 200°C. Samples of the new alloy are being supplied by the manufacturers to the U.S.A.F., to the Navy Bureau of Aeronautics, and to major aircraft companies for study and evaluation.

● **BEFAB, Borgs Fabriks AB.,** Norrköping, Sweden, is now producing BEFAB Safeland arrester nets for all aircraft up to a gross weight of 30 tons and a landing speed of 143 knots. The manufacturers claim the following advantages for their nets: little or no damage caused to aircraft; ease of erection and removal to another site; low installation costs. Safeland nets, which are patented in Sweden, were developed by the Royal Swedish Air Board and have already been ordered by several European countries.

● **Canadair Ltd.** has developed, in conjunction with W. R. Dand Petroleum Equipment and Gorman-Rupp Companies, a high-speed fuelling system for peak flow rates of 500 U.S. gals/Min; if required, the system, which has been developed for the CL-28 transport, also permits rapid emptying at 125 U.S. gals/min.

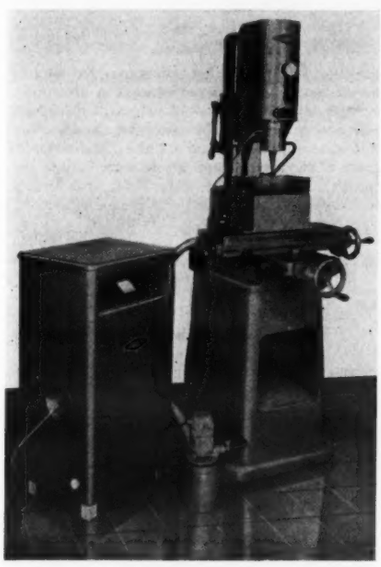
● **Sylvania Electric Products Inc.,** New York, has developed, by merging the sciences of lighting and electronics, a series of flat panel devices, known as " Sylvatron ", for the reproduction of electronic images. These panels consist basically of electroluminescent substances and photo-conductors, and can be divided into the following three types, depending on structure:

1. An electroluminescent panel on which the position of a mobile dot of light can be manipulated electrically;

2. A display panel which reproduces optically the track of a mobile spot of light. The image thus created can then be held or " stored " indefinitely in visible form on the panel;

3. An electroluminescent panel which can reproduce optically a motion picture with good resolution and rapid response. In its present stage of development it is a frequency converter, changing red or infra-red light into blue or green light.

Combinations of these three basic types at present known are the Sylvatron Type 12 (a combination of types 1 and 2) and Sylvatron Type 13 (1 and 3). Sylvatron 12 converts electrical data into dots of light or a track of light, and stores the resulting light combination, which could be visually reproduced as numbers, letters or pictures, while the Sylvatron 13 could electronically (as opposed to optically) reproduce motion pictures.

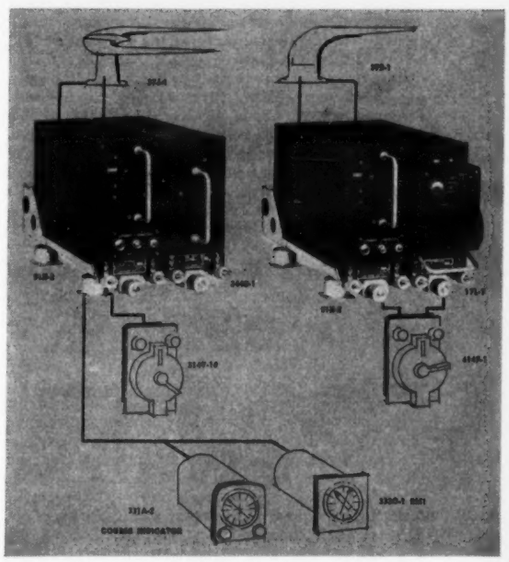


● **Dr. Lehfeldt & Co.,** Heppenheim, Germany, manufacturers of ultra-sonic equipment, makes the Diatron ultra-sonic drill (illustrated) which can be used on materials of any hardness, including metals, diamond, glass or porcelain. Holes of any desired shape can be drilled in one operation, with the edges of the holes being polished at the same time. Tolerances of a few thousandths of a millimetre can be maintained.

● **Collins Radio Company :** The Collins system of communications and ILS/VOR equipment consists of the 17 L-7 VHF transmitter, the 51 X-2 VHF communications receiver and the 51 X-2/344B-1 VOR receiving combination. The complete installation, including antennas, controls, shock-mounts and instruments, weighs only 57 lb. and occupies a space equivalent to a short 1 1/2 ATR.

The 17 L-7 transmitter is housed in a short 3/8 ATR, weighs 14 lb. and works with a power of 25 watts on 680 crystal-controlled channels in the 118 to 151.95 Mc/s band.

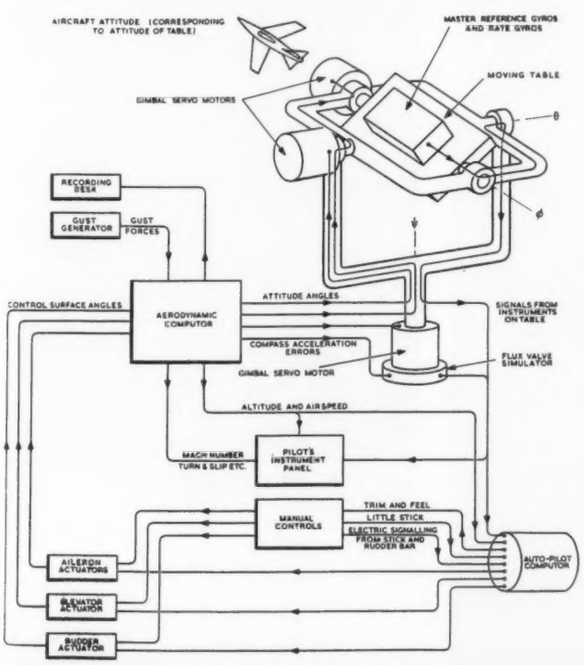
The receiver, also fitted in a 3/8 ATR, weighs 10.5 lb. and provides VOR, localizer and communications reception. 880 crystal-controlled channels in the 108 to 151.15 Mc/s band.



● **Sperry Gyroscope Company Limited,** Brentford, England, has built, in conjunction with development of the Sperry Integrated Control System, a simulator for testing control systems. With this simulator a complete aircraft control system can be developed to an advanced stage on a test rig, thereby effecting a drastic reduction in the usual flight development period.

The structure of the simulator is illustrated in the schematic diagram below. A gimbal-mounted moving table, controlled by three hydraulic servo-motors, simulates the attitude of the aircraft type under consideration. On this table are placed the gyroscopes and other instruments (master reference gyros and rate gyros), whose outputs are taken through slip rings to the central control device, known as the autopilot computer. The pilot's controls are coupled to the autopilot in the same way as in an aircraft, and control of the hydraulic actuators can be exercised electrically or by mechanical linkage, as selected by the operator. The hydraulic actuators drive loads which are adjusted to have the same aero-elastic properties as the actual control surfaces on the full-scale aircraft. To each control surface there is coupled a potentiometer from which voltages proportional to the control surface angles are derived. These, together with signals from a gust generator (to represent varying weather conditions), are fed into the input of an electronic analogue computer, which computes the aircraft's attitude in space as three voltages. The latter are used to drive the three servomotors on the gimbal table, thereby closing the simulation loop.

Other outputs of the analogue computer are height and air speed, which are used to drive the small servomotors geared to the instrument panel and to the barometric capsules in the autopilot computer. Further signals are Mach number and turn-and-slip signals for the instrument panel. A recording desk with six pen recorders and a twelve-channel photographic recorder is also provided.



What's in the Air ?

Extracts from Interavia Air Letter, *daily international news digest, in English, French and German. All rights reserved.*

AIR TRANSPORTATION

● **B.E.A. and B.O.A.C. equipment plans:** The re-equipment programmes for the two British airline Corporations are now virtually complete except for B.E.A.'s decision on a 600 m.p.h. short-range 80-seat jet and on helicopters. *British European Airways* will continue with *Viscounts* and *Elizabethans* until the latter are finally retired early in 1959; there will then be a period during 1959-60 when all main routes of the Corporation will be operated by *Viscounts* (types 701, 802, 806 and possibly 840); in the summer of 1960 B.E.A. will bring two new types into service simultaneously, the Vickers *Vanguard* and the *Comet 4B*, the ultimate fleets being 20 *Vanguards* and 6 *Comets*. 1963 is now the target date for the entry into service of the DH-121 or Bristol 200 airliners, with seating for either 70 or 100 passengers depending on the design finally chosen; if a decision is not made soon on this point, the target date may have to be postponed until 1964.

● **British Overseas Airways Corporation:** Over the next two to three years there will be a steady laying off of the *Argonaut*, *Constellation* and *Stratocruiser*. From 1958 onwards the *Britannia* will cover all North Atlantic, South African and Far East services, together with *Stratocruisers* and DC-7Cs on the Atlantic; from 1960 onwards the *Britannia 312* and Boeing 707 alone will cover the Atlantic services. The *Comet 4* will be introduced on to the Australian route in 1959 and later to the Far East, and the *Britannia 312*s then released will be transferred to the East Africa, West Africa and the Persian Gulf services to replace *Argonauts* and *Constellations*. If the Boeing 707 is a complete success on the North Atlantic service, the *Britannia 312* will take over the work of the *Britannia 102*, and the latter type may be sold off. B.O.A.C. is scheduled to take over its first 12 four-*Conway* VC-10s in 1963, and this aircraft will become the most important in the B.O.A.C. fleet from 1963 onwards and will be used on the African, Far East and Australian services.

● **Unified Austrian airline founded:** The hopes of Viennese air transportation circles, which since last July have been centred on a satisfactory outcome to the Austrian air transportation interests, were realized on September 30th with the formation of the Österreichische Luftverkehr A.G. President of the new company is Dr. Josef Joham, Managing Director of the Creditanstalt-Bankverein Vienna, and Dipl.-Ing. T. Trimmel and Sepp Froeschl are the two managers of the new company. The share capital of 60,000,000 Austrian schillings (approximately 2.5 million U.S. dollars) is divided up as follows: contributed by Austrian private investors 42%; by public enterprises, the City of Vienna and enterprises allied to the Socialist Party 28%; foreign investors, S.A.S. and Fred Olsen Flyselkap each holding 15%. The new company's fleet will consist initially of four Vickers *Viscounts*, leased by Fred Olsen for a three-year period commencing October 1st, 1957; the first route likely to be opened is Vienna-Zürich-London.

● **Silver City Airways Ltd.** has announced substantial vehicle fare reductions on its cross-Channel air ferry service between Ferryfield Airport (Lydd) and Le Touquet or Calais. For example, a car not exceeding 11 ft. in length now costs £3.10.0. by air against £4.0.0. for the sea passage. For the first time, for smaller types of cars, the equivalent air fare is now lower than the boat fare. These reductions will apply until March 31st, 1958.

● **Pratt & Whitney JT4 engines** are to be fitted to the four Douglas DC-8s which are on order by Transports Aériens Intercontinentaux.

● **Northeast Airlines** have deferred their order for five Bristol *Britannia 305*s, which are now to be delivered in 1958; the company had originally planned to bring the *Britannias* into service on the New York-Florida route for the peak season during the winter of 1957/58. Following a delay of eight weeks in Bristol's production schedule, caused by C.A.A.'s modification requirements, Northeast would have been unable to operate the *Britannias* during the winter's peak season and did not wish to bring them in late as " coach service " aircraft. As these lines go to press the T.W.A.—*Britannia* deal has not been finalized, but if and when it does mature, the four Northeast *Britannia 305*s will possibly form part of the transaction.

INDUSTRY

● **Boeing is in the civil market to stay** and has widened the family of Boeing jet aircraft, both the smaller and larger versions, announces Harold Mansfield, the company's Public Relations Director. This would seem to indicate that an enlarged version of the intercontinental 707 is in the offing; according to *Interavia*'s London Editor, Mansfield confirmed that the engine companies had promised to cooperate.

● **The Westinghouse Electric Corp.** has developed a test facility which duplicates the intense heat encountered by missiles travelling at almost 5,000 m.p.h. through the earth's atmosphere. The unit which is designed to study the effect of high temperatures on aircraft and missile structures, can create a temperature of 2,500°F in twelve seconds. Orders for this facility have already been placed by the Martin Company, Convair Division of General Dynamics Corp. and the Chrysler Corporation's Missiles Operations Division.

● **English Electric is considering taking over the Squires Gate aircraft factory at Blackpool** which was previously leased by the Ministry of Supply to Hawker Aircraft for *Hunter* production. It is believed that the company may put in a second P.1 production line at Squires Gate. The success of the aircraft appears to have caused the Air Ministry to speed up delivery time, and further developments for other roles may be ordered.

● **Electravia S.A., a new company formed in Geneva,** has purchased the facilities belonging to Lear S.A. at Geneva-Cointrin Airport and is now reorganizing the existing service station and sales organization. The firm will act as agents for Lear products, and plans to take over other aircraft and electronic agencies.

MILITARY AFFAIRS

● **Inter-Service rivalry will not be tolerated** by Neil H. McElroy, new U.S. Secretary of Defense, if it threatened to jeopardize defence teamwork, produce wasteful duplication of effort, or undermine the public's confidence in the nation's military organization. At his initiation ceremony, McElroy stated that the United States is considering a speed-up in its ballistic missiles programme which would probably take the form of more numerous test launchings, more overtime work at missiles centres and more rapid evaluation of missile data.

● **The Swedish Air Force requests more funds:** The estimates prepared by the Air Force leaders call for an expenditure of Kr. 1,134,000,000 for the financial year 1958/59. In a memorandum accompanying the estimates the Air Force states that the future role of missiles cannot yet be determined and that: " Over a period of years the Swedish Air Force has been built up in accordance with

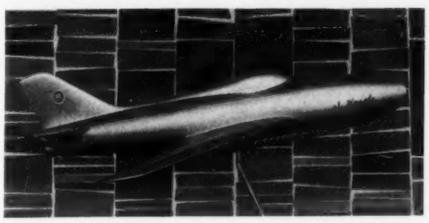
The first Avro CF-105 twin-jet two-seat interceptor and fighter-bomber has now been completed by Canada's Avro Aircraft Ltd. The company has announced that the first phase of the flight test programme will comence towards the end of December this year. Available data : top speed 1,300 knots ; gross weight approx. 34 tons ; ceiling roughly 12 miles (30,000 feet) ; time of climb to ceiling 3-4 minutes.

Shown for the first time at the recent Defence Exhibition in Göteborg was a new guided missile with Svenska Flygmotor integral ramjet engine, type RR-1. The missile, of which no full details are yet available, is initially accelerated to sonic speed by the two take-off booster rockets, after which the ramjet will take it to speeds in the range of Mach 5 or 6.

Brigadier General Domenico Ludovico has been appointed head of the Difesa Aerea Territoriale, Italian Air Force headquarters.

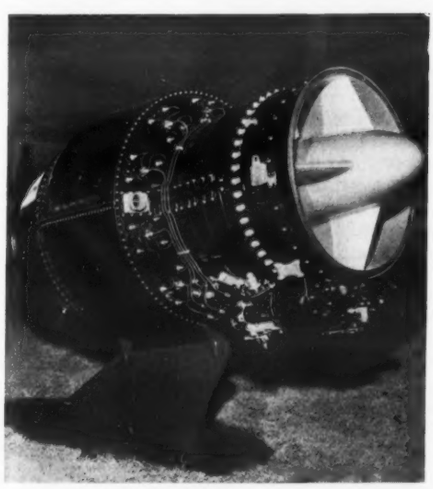
The Italian Government has appointed General Mario Porru Locci (left) to be Secretary General of Defence (Air) in succession to General Mario Pezzi (right).

Visit of the SE.210 *Caravelle* to Athens. *Extreme left* : Air Vice Marshal (rtd) George Doukas, Director General of the Greek Civil Aviation Administration, in the company of Achille Auban, Under Secretary of State for Civil Aviation, Georges Héreil, President and Director General of Sud-Aviation, and Aristotle Onassis, President of Olympic Airways.



A model of the Italian Aerfer *Ariete II*, which was shown for the first time at the Turin Show. The *Ariete II* is powered by a Rolls-Royce *Derwent* 20 jet engine, and also has a Rolls-Royce *Soar* as auxiliary power for take-off, climb, etc.

The Saunders-Roe P.177 (SR.177) will have a mixed propulsion system—de Havilland *Gyron Junior* jet plus de Havilland *Spectre* rocket engine. A pre-production batch of P.177s is under construction for the Royal Navy, and Germany is also reported to be taking an intense interest in the project.



the decisions taken by the Riksdag and has been supplied with modern equipment most of which was developed and manufactured in Sweden. The development of new flying equipment requires several years, and foresight and much long-term planning are needed as well as continued adjustment to the rapid advances of technology. To what extent missiles will take over the work of manned aircraft in the future cannot be determined now. Until a decision can be made, future development and procurement of new weapons must include both manned aircraft and unmanned missiles ".

● **Guided missiles will be supplied to Italian armed services** under three different programmes, according to a statement by Defence Minister Paolo Emilio Taviani. Programme 1 calls for deliveries by foreign manufacturers under the N.A.T.O. Mutual Assistance Pact; Programme 2 provides for licence and manufacture in Italy of models of foreign design; Programme 3 calls for the production of Italian-designed missiles at costs lower than those required by foreign designs. Taviani emphasized that the supply of missiles under the N.A.T.O. programme, and the acquisition of licences from abroad will in no way jeopardize the production of weapons of Italian design.

AIRCRAFT AND POWERPLANTS

● *Kolibri 1* is the designation of the three-seat helicopter being developed by Borgwald-Focke under the supervision of Prof. Focke. The *Kolibri 1* will achieve a top speed of 86 knots and is powered with a 260 h.p. Lycoming. A prototype of this rotary-wing aircraft should be ready for tests before the end of 1957.

● *The Grumman Gulfstream* will be handled by three sales agents which Grumman Aircraft Engineering Corp. has appointed: Atlantic Aviation Service Inc., Philadelphia; Pacific Airmotive Corp., Burbank, Calif.; Remmert-Werner Corp., St. Louis, Mo. Grumman has also announced that the *Gulfstream* (originally known as " Design 159 ") powered by two Rolls-Royce *Darts*, is to have a pressure cabin and, in the normal version, accommodation for 10-12 passengers; several other interior layouts, e.g., for 19-20 passengers, will also be available. The first prototype is scheduled to fly on May 1st, 1958, and a second aircraft should be completed soon afterwards, so that two models will be available for flight tests and the certification programme (category 4b). First deliveries can be expected in 1959, and orders have already been received. The *Gulfstream* will be able to take off, fully loaded, from runways only 4,000 ft. in length, and will have a max. range of 1,900 nautical miles; max. cruising apeed at 25,000 ft. will be 320 knots. Other data: span 78 ft.; length 64 ft.; gross weight approx. 31,000 lbs.

● *A Mach 2 ramjet target drone*, the Q-5, is under development at the Lockheed Aircraft Corp. Van Nuys, California, plant. Remote control is from a mobile ground station. Weight 7,600 lbs. plus; span 10 ft.; length approx. 39 ft.; diameter 20 ins.

The Fiat 4032 turbojet with 9-stage axial compressor, annular combustion chamber with 10 burners, single-stage turbine. This new power unit, shown by Fiat for the first time at the Turin Engineering Show, has a maximum sea-level static thrust of 6,610 lb.

● *An $8,000,000 U.S.A.F. contract* to continue development of a " new and greatly advanced turboprop engine " has been confirmed by the Allison Division of General Motors Corporation. It was disclosed that work on the engine, the Model 550, has been underway since 1955 entirely at Allison expense, and that a prototype model has been built and testing begun in advance of any military contract support. Details of the new engine have not been disclosed, but it was emphasized that the Model 550 is an entirely new engine rather than an improved version of the T56 (presently rated at 3,750 eshp and soon to be qualified at 4,050 eshp). The new model will be rated substantially higher than the T56, but with little increase in size or weight.

● *Russia is working on VTOL aircraft*, according to a Tass report from Moscow. A jet-powered experimental vehicle, which Western observers have described as being roughly similar in appearance to France's *SNECMA Flying Atar*, is being tested.

● A second series of tests is being carried out on the *SNCA du Nord Griffon interceptor ;* this series is mainly concerned with tests of the ramjet power units.

● *A new SEPR Rocket engine* has been announced. This engine is of the non-independent variety, developing a thrust of 3,310 lbs.

● *The delta-wing SNCA du Nord Gerfaut interceptor* is continuing a series of tests involving interception and missile firing. The programme also includes test firings at supersonic speeds of missiles mounted below the fuselage.

● It is now known that Italy's *Aerfer Company's Ariete fighter* is powered with a Rolls-Royce *Derwent 20* jet engine and also a Rolls-Royce *Soar* as auxiliary power for take-off, climb, etc. The *Ariete* was recently exhibited for the first time at the Turin Engineering Show.

● Also at the Turin show, Fiat exhibited for the first time the *Fiat 7002—an entirely new helicopter :* this is a single-engine type with dual controls, two-blade main rotor equipped with pressure nozzles, and powered by the new Fiat 4700 turbo-air generator. Gross weight is 3,090 lbs., weight equipped is 1,320 lbs.; design max. speed 92 knots; service ceiling with max. gross weight 11,150 ft.; endurance 3 hours. The cabin has accommodation for the pilot plus six passengers, or four stretcher cases and an attendant, or an equivalent cargo.

● *A new business aircraft—the Crescent Executive* is under development by the Crescent Aircraft Corp., Lafayette, Louisiana; this is a twin-engine all-metal low-wing monoplane with hydraulically retractable nose-wheel undercarriage (designed especially for use on semi-prepared airfields); the two-seat cockpit has dual controls and full instrumentation, and the pressurized passenger cabin can accommodate six persons. Two 520 h.p. Lycoming straight-eight engines with superchargers, Hartzell three-blade propellers; span 45 feet; length 39 feet; top speed 260 knots; rate of climb approx. 2,000 f.p.m.; take-off and landing distance with allowance for safety margin 2,000 feet.

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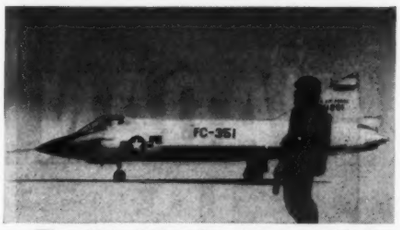
man aloft



The pilot – before he set eyes on this jet, before he set hand to the actual controls – had already "flown" it. He learned how, on the ground, in a Link F-102 Simulator . . . one of more than a million fliers who have logged "Link time." Millions more will. A number of the world's principal air lines, among them BEA, BOAC, KLM, QANTAS, SAS and leading U. S. carriers, already have purchased Link Simulators to train pilots and crews for tomorrow's jet transport flights.

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Some comments on the

INTERAVIA ABC

Directory of World Aviation (1957 edition)

Permettez-moi de vous féliciter pour ce travail magnifique, digne de tout éloge. Je ne manquerai pas de signaler cet ouvrage aux personnes qu'il pourrait intéresser.

Directeur de l'aviation civile (Syrie)

..., publicación que ha sido admirada por su nitidez de presentación y vasto acopio informativo.

Ministerio de la guerra, marina y aviación (Nicaragua) Tte Inf. GN.

The Technical Library of the Civil Aeronautics Administration is making good use of the Interavia A.B.C. Directory as ready reference.

Civil Aeronautics Administration (Philippines) Av. Educ. Inf. Officer

The Book is most comprehensive and well laid out and printed—very useful for reference.

Director of Information Services (Government, Colony of Singapore)

Je tiens à vous redire encore tout le bien que nous pensons de l'A.B.C. Interavia qui constitue un instrument de travail extrêmement précieux.

Institut du transport aérien (International) Liaisons Extérieures.

Al respecto, cúmpleme manifestarles que después de estudiar detenidamente dicho volumen, hemos llegado a la conclusión de que es una obra verdaderamente completa y digna de las más efusivas felicitaciones.

Ministro de obras públicas y comunicaciones (Ecuador)

Your directory carries quite a vast compilation of good aviation data and we certainly value the opportunity of being represented.

Thompson Products, Inc., (Ohio, U.S.A.)

... gives the fullest information about military and civil aviation.

Cape Times, Cape Town

Nous tenons à vous féliciter pour votre Interavia ABC qui est un livre extrêmement utile et à notre avis le meilleur dans son genre.

Transair S.A., Neuchâtel

If you are looking for a Government department, a flying organization, an aeronautical firm, ... the directory has the appropriate information.

The Star, Johannesburg

There is not much doubt that this is probably the most comprehensive international aviation directory which we have ever seen.

Aircraft Magazine, Toronto

Das INTERAVIA ABC hat schon in den ersten Wochen, nachdem es als Besprechungsexemplar in unsere Hände gelangt war, seinen Wert bewiesen.

Luftfahrttechnik, Düsseldorf

... ein unentbehrliches Hilfsmittel für alle in der Luftfahrt Tätigen, da er ohne zeitraubende Recherchen buchstäblich im Handumdrehen vollgültige Informationen zu geben vermag.

Deutsche Verkehrs-Zeitung, Hamburg

Das schon vor dem Kriege bekannte Nachschlagewerk... dürfte sich ohne Zweifel für alle an der internationalen Luftfahrt interessierten Stellen als ein überaus wertvoller Ratgeber erweisen.

Handelsblatt, Düsseldorf

..., el Anuario « Interavia ABC » es indispensable a todos los que tengan alguna relación con la aviación, en cualquiera de sus facetas.

Avión, Madrid

..., the book is an indispensable tool all those engaged in any of the multiple branches of international aeronautics.

The Amarillo Sunday News-Globe (Texas)

U.S. listings top all in World Air Directory.

Army, Navy, Air Force Journal, U.S.A.

... is probably the finest compilation of the great mass of information on aviation and kindred subjects...

The Evening Star, Washington

... is a formidable work both in the amount of material it contains and in the ground it covers.

Aeronautics, London

When a none-too-bright American had been given the London telephone directory to read while waiting for an appointment someone jocularly asked him what he thought of it. « Waal », he replied cogitatively, « there's not much of a plot. But gee, it's a magnificient cast ! » Much the same might be said of the new Interavia ABC...

Flight, London

De enorme groei van de luchtvaart na de oorlog kwam vooral tot uiting in de zgn, « analyt »-afdeling, waarin alle international luchtvaartorganisaties, instituten, maatschappijen, opleidingsscholen en clubs, alle vliegtuigfabrieken en aanverwante industrieën, vliegvelden en landingsterreinen voorkwamen.

Algemeen Handelsblad, Rotterdam

De nieuwe uitgave van Interavia ABC, het bekende internationale handboek voor allen, ...

Nieuwe Rotterdamse Courant Rotterdam

A reference to Interavia ABC is the quickest way to put one's finger on anything connected with aviation anywhere in the world...

The Hindu, Madras

Questa pubblicazione, la più completa nel suo genere, offre al lettore una aggiornatissima gamma di notizie di interesse aeronautico e costituisce un elemento di consultazione e di analisi veramente imponente.

L'Ala d'Italia, Milano

Crediamo, difatti, che questa sia la migliore definizione da darsi al volume Interavia 1957 che con la sua mole e con la sua struttura ha diritto ad essere definito unica pubblicazione del genere nel mondo. Più che un Annuario è un repertorio di nomi, cifre e dati di carattere strettamente pratico e di importanza consultativa non equivocabile.

Ali, Roma

Validissimo elemento di consultazione, veramente interessante e completo, era attesa da tutti coloro che si occupano di aviazione.

Notiziario Aeronautico, Roma

... we feel sure of the fact that the present edition can, furthermore, meet with the great satisfaction of ours because of their up-to-date and thorough-going informations...

Japan Aeronautic Association, Tokyo

... utomordentligt välredigerade verket...

Flyg Revyn, Stockholm

Für den Fachmann auf jeglichem aviatischem Gebiet bildet das Interavia ABC ein unerlässliches Nachschlagewerk... Es ist das « Who is who » der Weltluftfahrt und darüber hinaus eine Arbeit, welche die riesige Entwicklung der Aviatik schon durch den Umfang und das Gewicht des Buches aufs deutlichste dokumentiert.

Schweizer Aero-Revue, Bern

Grâce à l'initiative d'Interavia ABC nous possédons, avec l'édition 1957 (cinquième livraison), le seul annuaire d'aviation vraiment international. Cet ouvrage est d'une consultation aisée...

La Gazette de Lausanne, Lausanne

The 1958 edition will appear next April. Further details from your INTERAVIA representative.

Book Reviews

Britain's Air Survival. By Sir Roy Fedden. Cassell & Co. Ltd., London. (English: 142 pages, 11s. 6d.).

With a lifetime of technical and administrative activity in and on behalf of the aircraft industry Sir Roy is one of Britain's leading aeronautical experts. In this book he calls for a radical change in Britain's aircraft planning and production system, firstly to avoid further dissipation of resources on abortive projects, and secondly to provide the necessary technical staffs, not only in the industry itself but also within governmental fields. Although sheer economic necessity has recently achieved at least part of the rationalization which he demands, Sir Roy's warnings will find many supporters within the industry. One of the industry's keenest critics, Sir Roy Fedden is its most ardent supporter and there can be no doubt that his words are inspired by deeply patriotic motives. Ru.

Essais en vol. By Neville Duke, Paul Boudier and William Bridgeman, with preface by General Chambe. Edited and published by Amiot-Dumont, Paris, 1957. (French, 303 pages).

A joint work by three famous test pilots—Britain's Neville Duke, France's Paul Boudier and America's William Bridgeman. This work has been inspired by Amiot-Dumont, the French editor of " Victoire sur le ciel ", " Ils ont reconquis notre ciel " and " Solitude du ciel ", in order to provide a vehicle for the diverse yet complementary experiences of the three pilots. It is not simply a reprint of three stories within one cover, but rather an attempt to present the three stories, without anecdote, as a complete work on one theme, and to underline the significance of their work. All three men have participated in this reconstruction, for which Neville Duke has written a new final chapter. So.

25th Airport and Business Flying Directory. McGraw-Hill, New York, 1957. (English: 364 pages).

This standard work contains revised 1957/1958 listings of airport facilities, flight information, recommended hotels/motels and buying specifications covering the entire United States. A hip-pocket " must " for professional and business-pleasure pilots. Ru.

Taschenbuch für Wehrfragen 1957/58. Compiled by H. E. Jahn and K. Neher, in conjunction with the West German Defence Ministry (2nd edition). Published by Festland Verlag, Bonn, 1957 (German: 534 pages).

An indispensable reference book providing rapid and accurate information on the foundation and details of the West German Defence Ministry. In pocket-book form with thumb section index and subject index, town index, personnel index, maps and colour tables. Contents include outlines of post-war events in German history, the build-up of the defence policy, the armed forces—Army, Air Force and Navy, armed forces administration, defence economy, equipment and weapons, and short biographical details of leading personalities. He.

QUAX Atlas für Luftfahrer. Published by QUAX, Frankfurt on Main; manufacturers and copyright holders of the maps: Ravenstein Geographische Verlagsanstalt, Frankfurt, 1957 (German, price DM 48.55).

Based on the excellent maps published by the Ravenstein house, this atlas is available to all members of the *German Aero Club* at cost price, and offers the sports flyer and the tourist the possibility of familiarizing himself with Bundesrepublik terrain both before and during flight. An overall 1:2,000,000 map presents the whole of Germany and the neighbouring countries, and permits the course to be plotted. The coloured sectional maps, 1:300,000, contain a wealth of well defined and easily read features: mountains, forests, railroads, highways, civil, military and gliding airfields (height above sea level), radio beacons, airport control areas, air corridors, ADIZs and restricted areas (the interzonal boundary is marked in heavy red). A graduated scale reading kilometers, miles and nautical miles is attached. This is a most interesting work which will be of special value to private flyers. He.

English in the Air. Leerboek voor het Vliegtechnisch Engels. By D. R. Bouhuys. 2nd edition. Uitgeversmaatschappij C. A. J. Dishoeck, Bussum, 1956. (English-Dutch, 230 pages).

More than a dry English-Dutch glossary of aviation technical terms, but yet a handy reference book. Illustrated by more than 150 drawings, the book provides a listing of the most important aviation terms and expressions in English, Dutch and—where they differ from English—American. A number of slang expressions are also included. The glossary in each chapter is supplemented by anecdotes and short stories by well-known writers (Nevil Shute, Pierre Clostermann, John Steinbeck, Neville Duke, etc.). The whole is, of course, written primarily for readers of Dutch mother-tongue. Ha.

La propulsion par fusées. By Marcel Barrère, André Jaumotte, Baudouin Fraeijs de Veubeke and Jean Vandenkerckhove, with a preface by Maurice Roy. Dunod, Paris (French, 392 pages, illustrations, 5,600 French francs).

Despite its ancient origins, rocket propulsion has only been really developed during the past few years, as the apparent simplicity of the system conceals substantial technical difficulties.

Because these problems are new, engineers need scientific documentation on the subject which is as accurate, detailed, complete and up-to-date as possible.

Although written by four authors in cooperation, the book reveals a remarkable unity. It makes accessible to the reader the results of recent experimental work carried out at ONERA in France by a group of French and Belgian scientists working in close collaboration.

The value of this book and the prospects of which it gives a glimpse cannot be over-estimated. So.

Grundriss der Luftfahrtmedizin. By S. Ruff, H. Strughold. 3rd edition, revised and enlarged by Professor Siegfried Ruff, head of the Institut für Flugmedizin, Deutsche Versuchsanstalt für Luftfahrt. Johann Ambrosius Barth, Munich, 1957. (German, 263 pages, 154 illustrations, 12 tables).

The past few years have seen an unprecedented increase in the range, ceiling and speed of modern flying equipment, and today development has reached the stage where travel beyond the earth's atmosphere can already be regarded as feasible. Technical advances, however, make increasingly stringent demands on the mental and physical qualities of the men in the aircraft. For example, the speed already attained by aircraft is already more than twelve times the human organism's nerve transmission speed. The book discusses, in six profusely illustrated chapters, the many problems confronting aviation medicine, with an especially clear presentation of questions of flight hygiene and the treatment of accidents. The book is addressed not only to students of medicine and medical officers, but also to engineers, flying instructors and pilots, as well as all who are interested in flying. Ha.

Gas Dynamics (Volume One of the " Applied Mathematics and Mechanics " series). By Klaus Oswatitsch; English version by G. Kuerti. Published by the Academic Press Inc., New York, 1956 (English; 610 pages; price $12.00).

The author enjoys world renown as a leading aerodynamicist and Director of the Institute for Theoretical Gas Dynamics of the Deutsche Veranstalt für Luftfahrt in Aachen. This volume is mainly a translation into English of Oswatitsch's " Gasdynamik " which was published in 1952, but certain passages have been condensed and additions made to incorporate results of research obtained since the first publication. This is in particular true of the reference list in which over 100 works are noted and which, for the sake of clarity, has been divided up according to the book's twelve sections. As Editor-in-Chief of these monographs, F. N. Frenikel of the Applied Physics Laboratory of the Johns Hopkins University, Maryland, is responsible for the task of continuing the series with " Jets, Wakes and Cavities " and " Theory of Compressible Fluid Flow ". Re.

(contd. on page 1176)

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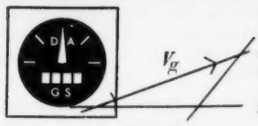

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Flugsicherungstechnik I (Navigationsanlagen). By Dr.-Ing. Karl Bärner; Volume 5 of the series " Die Bücher der Luftfahrtpraxis "; edited by Dr.-Ing. H. J. Zetzmann. Published by the Hanns Reich Verlag, Munich, 1957 (German; 278 pages with 239 drawings and illustrations; price DM 16.80).

This volume deals with high frequency techniques in the fields of aircraft navigation, of approach and landing. Navigational radio beacons, four-course beacons, marker beacons, omni-range beacons, distance measuring equipment, hyperbolic navigational equipment, instrument landing systems, ground-based direction finding, and airborne equipment are not only discussed in detail according to their design, but also with respect to their technical methods of operation, their operational controls and their check measurements. This work is of exceptional value to all those concerned with flying control, as well as those interested in other technical fields requiring basic knowledge on high frequency and antenna techniques. Readers may be grateful for the omission of higher mathematics. Na.

Motor- und Segelflug; Leitfaden für Motor- und Segelfliegerprüfungen (2nd Edition). By Dr. A. Bodlée; published by the Hanns Reich Verlag, Munich, 1957 (German; 192 pages; 86 illustrations, coloured flight training map; price DM 8.80).

In this popular handy guide for future pilots, the author and publishers make a valuable contribution to the revival of a German " Pilots' Guild ". Basic ideas on aerodynamics and aircraft construction; engines; accessories, navigation, meteorology; air law—everything that the future pilot must know before he takes his place in the cockpit—are offered in a condensed form. This 2nd enlarged edition has a great deal of supplementary information. He.

United States Air Force Parachute Handbook. Published (at the end of 1956) by the Wright Air Development Center, Patterson Air Force Base, Ohio. Available from the Office of Technical Services, U.S. Department of Commerce, Washington (English; 339 pages; price $6.00).

This parachute handbook was prepared by personnel of the Parachute Branch, Equipment Laboratory, WADC, and contains a wealth of information on the design, testing and application of parachutes and their accessories. From the harness adapter to the performance diagrams for the various parachutes and the most complex electronic testing equipment, the reader finds an abundance of condensed precise data on all types of parachutes: personnel rescue, aerial delivery, aircraft deceleration. Of particular interest is the illustrated glossary of parachute terms and the bibliography, published by the Wright Air Development Center. He.

Books received

Publications scientifiques et techniques du Ministère de l'Air. — Distributed by the Service de documentation et d'information technique de l'aéronautique, Paris:

No. B.S.T. 119: *La rénovation de la soufflerie S3 du service technique aéronautique*, by Robert Lecardonnel.

No. N.T. 64: *Microdébitmètre à perte de charge D.F.G.*, by F. Debeauvais.

No. N.T. 65: *Les Séries chronologiques et la théorie du hasard*, by M. Kiveliovitch and J. Vialar.

No. 326: *Le mécanisme de la coupe des métaux*, by Roger Jouty.

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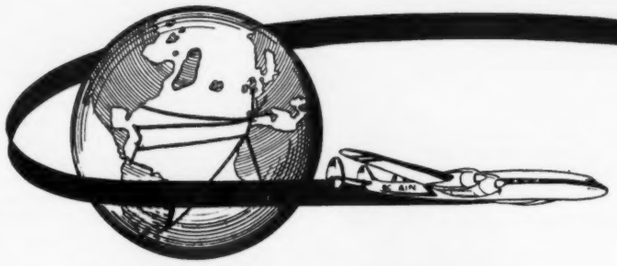

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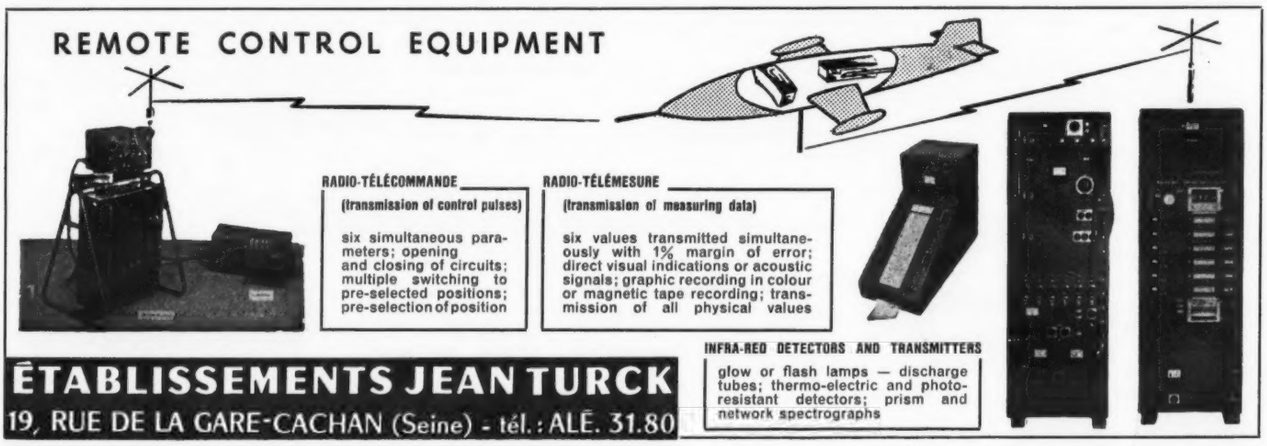

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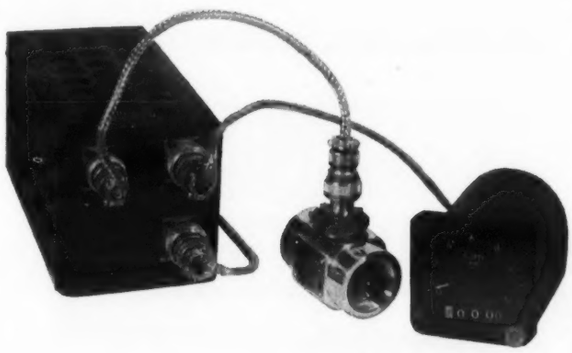

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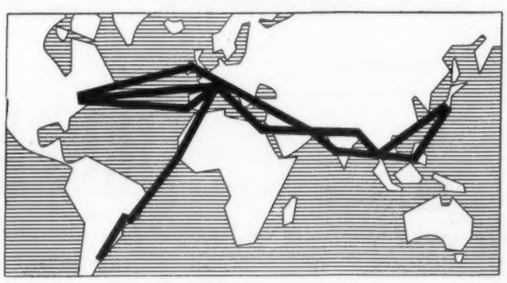

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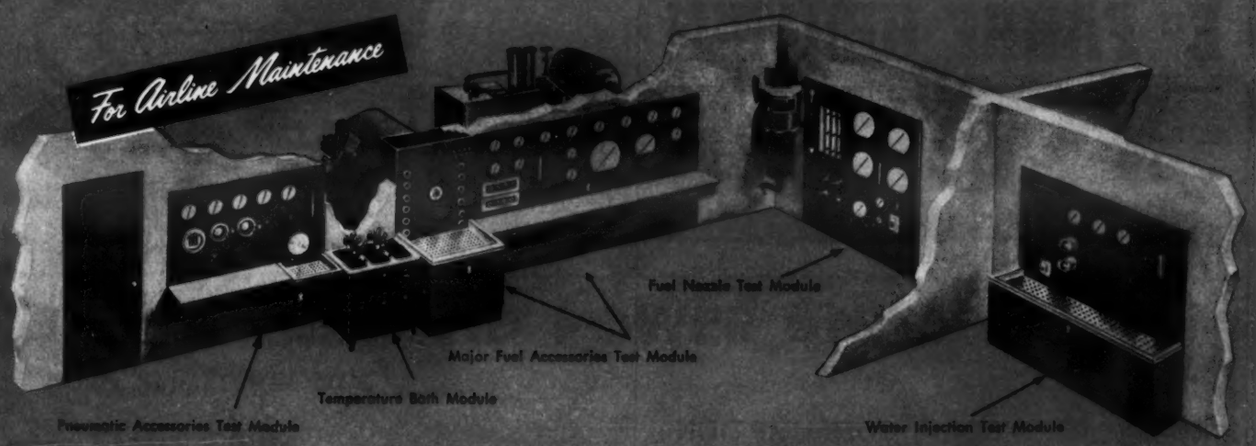

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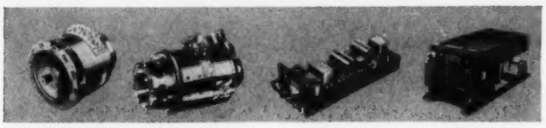

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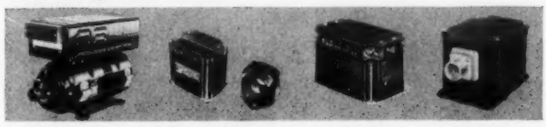

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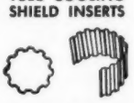

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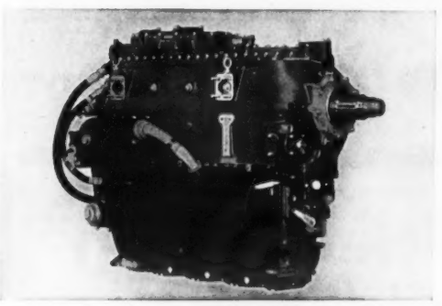

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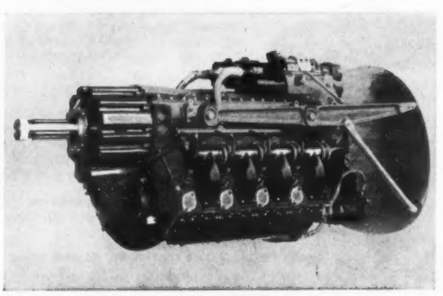

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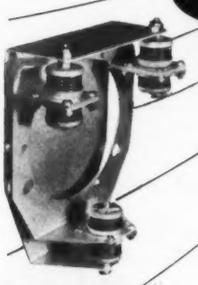

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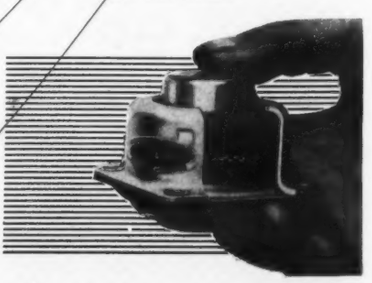

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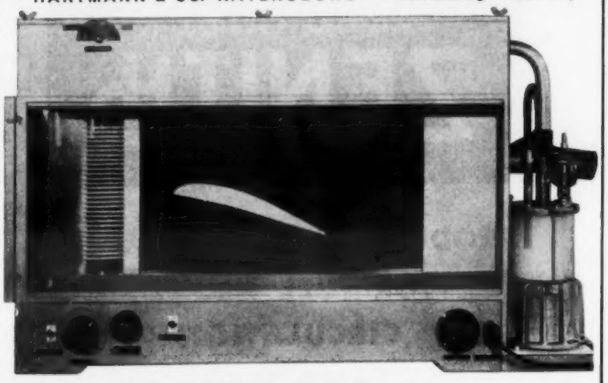

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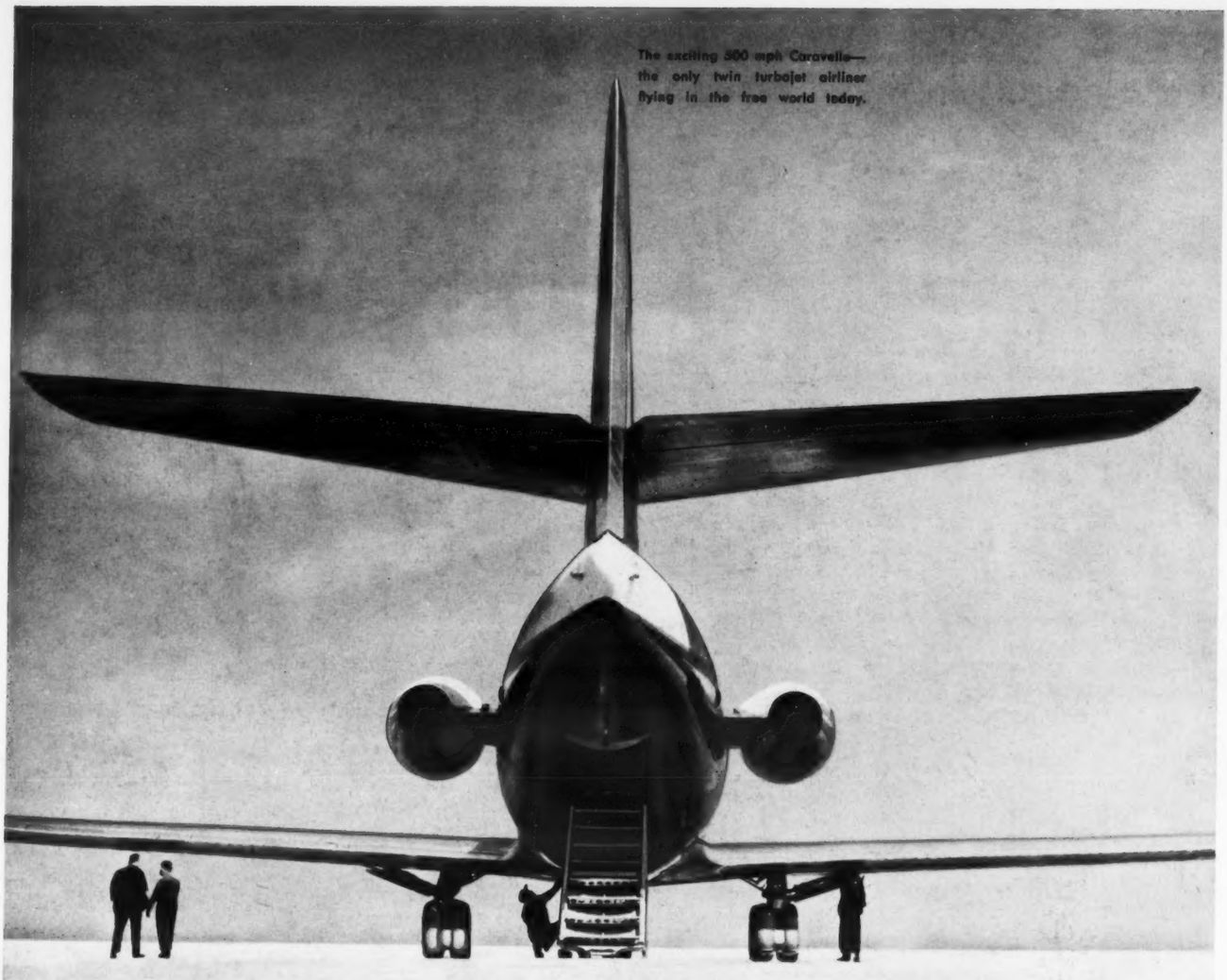

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